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TECHNOLOGY AND EMPLOYMENT

JOINT HEARINGS

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY

AND THE

TASK FORCE ON EDUCATION AND EMPLOYMENT

OF THE

COMMITTEE ON THE BUDGET
U.S. HOUSE OF REPRESENTATIVES

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TECHNOLOGY AND EMPLOYMENT

TUESDAY, JUNE 7, 1983

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY; SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY, AND THE COMMITTEE ON THE BUDGET, TASK FORCE ON EDUCATION AND EMPLOYMENT,
Washington, D.C.

The subcommittee and task force convened, pursuant to call, at 9:40 a.m., in room 2322, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Present: Representatives Walgren, Gephardt, Lundine, Gregg, Boehlert, Sensenbrenner, McGrath, Skeen, and Bateman.

Mr. WALGREN. Let me call us to order.

Today is the first day in a series of what will be 7 days of hearings on technology and employment. These hearings are being held jointly between my Subcommittee on Science, Research and Technology and the House Budget Committee's Task Force on Education and Employment which is chaired by my colleague, Congressman Dick Gephardt.

I would like to thank Congressman Gephardt and his Task Force for their cooperation in arranging these hearings.

I hope these hearings can be a fruitful effort.

The setting for these hearings on technology and employment could not be more appropriate.

First, the nationwide jobless rate continues its near-record levels of 10 percent, which means over 11 million American workers are unemployed. We all know that that is a large understatement of the actual unemployment in our society. In some sectors of the national work force, the jobless rates are nearly 20 percent.

Second, the very existence of some of the basic manufacturing industries, such as steel and autos, is seriously threatened by international competition. In these industries, a large segment of American workers face the very real possibility of permanent unemployment. There are many towns and sections of the country where large portions of their work force face the prospect of permanent unemployment—something they have not experienced in the cyclical recessions of the past.

Third, the technological lead that our Nation has so long enjoyed is rapidly eroding in many fields. Our international competitors continue to increase their national funding for research and development, improve their industrial productivity, and upgrade the quality of certain goods and services.

Fourth, a report by the National Commission on Excellence in Education has recently told us that excellence is missing in our precollege education system. This report brings into serious question the ability of our Nation to train and educate our future work force.

Finally, our factories, farms, and offices are undergoing dramatic changes in which technology is playing a central role in the manufacture of goods and provision of services.

While these changes mean improved productivity in many cases—and in some cases new kinds of jobs—they are certainly extremely threatening and involve severe dislocation.

I do not expect that these hearings will provide us with immediate solutions to the national problems I have just mentioned. However, I do hope that we will compile from our many distinguished witnesses a great deal of timely information and recommendations. This information will help us to identify how technology is leading to changes in the Nation's work force and work environment, and what the proper Federal role can be. The recommendations will help us to find ways that the Government can ease the adjustment of the work force to technology while promoting employment and economic growth.

I would like to submit for inclusion in the record a copy of the prospectus for the hearings.

[The information follows:]

PROSPECTUS

HEARINGS ON TECHNOLOGY AND EMPLOYMENT

I. OBJECTIVES

The objectives of the hearings are the following:

1. To identify how technology is leading to changes in the nation's work force and work environment.

2. To make recommendations for government action which will ease the adjustment of the work force and the workplace to technology, while promoting employment, improved productivity, and economic growth.

II. BACKGROUND

During the past several decades, the United States and most other industrialized nations have been undergoing a transformation of the work environment that rivals the changes resulting from the Industrial Revolution. Technological innovations have led to increased productivity and output in many of our nation's traditional industries, such as agriculture, mining, construction, and consumer goods manufacturing, and have spawned entirely new industries involving microelectronics, computers, biotechnology, and advanced materials. These developments have altered the context of work beyond the substitution of mechanical force for human labor, which characterized the Industrial Revolution. Technologies now also substitute for human information processing, as illustrated by automated factories and laboratories, or the ability of computer chips to design other chips.

Such technological innovations may offer the promise of economic progress and employment opportunities, but there is also growing concern over technologically induced unemployment, dislocations of workers, and obsolescence of workers' skills. Furthermore, prospects for adjustment to technology must account for changes in the social and economic environment of the nation. For example, we currently face a slowed economy, increasing international competition in the world marketplace, significant unemployment in several industrial sectors, such as steel and automobile manufacturing, and changes in the demographics of the nation's workforce.

There is little published research that provides definitive answers for the growing public debate over whether the adoption of technology in the workplace contributes to unemployment and economic disarray or whether its adoption creates more jobs and an expanding economy. One of the last major studies of the impact of technology on employment was reported in 1966 by a presidentially appointed National Commission on Technology, Automation and Economic Progress.

In 1982 a Congressional study entitled "Location of High Technology Firms and Regional Economic Development" was published by the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee. The Congress has also recently requested the Office of Technology Assessment to perform studies of a number of issues related to technology and employment. These on-going studies include "Technology, Innovation, and Regional Economic Development," requested by the House Committee on Science and Technology and the Senate Committee on Commerce, Science, and Transportation, and "Manufacturing Automation: Selected Employment and Education Issues," requested by the Joint Economic Committee, the Senate Committee on Labor and Human Resources, the Senate Committee on Commerce, Science, and Transportation, and the House Subcommittee on Labor Standards.

There have also been several recent Congressional hearings which address some of the issues on technology and employment. These hearings include "Productivity in the American Economy 1982" by the House Subcommittee on Employment and Productivity, "Human Factors in Innovation and Productivity" by the House Subcommittee on Science, Research and Technology, "Prospective Impact of Robotics on Employment" by the Joint Economic Subcommittee on Economic Goals and Intergovernmental Policy, and "Impact of Technology on Jobs and Methods for Job Forecasting" by the House Subcommittee on Investigations and Oversight of the Committee on Science and Technology, and "The Impact of Robots and Computers on the Work Force of the 1980's" by the House Subcommittee on General Oversight and the Economy of the Small Business Committee.

The planned hearings differ from these previous Congressional hearings in two important respects. First, the earlier hearings focused on one or two specific subjects, such as job forecasting, factory robotics, or human factors in innovation and productivity. While these hearings have provided useful information on such topics, these hearings have also demonstrated the need for a broader view of the complex relationship between technology and employment. The planned hearings are, therefore, designed to be very comprehensive in scope in the following ways: (1) inclusion of most of the major issues raised in the growing public and Congressional debate over the impact of technology on jobs; (2) recognition of the strong interdependence of many of the issues which have previously been treated separately; and (3) consideration of a broad range of factors including a number of traditional and emerging industries, many established and new job categories, several different regions of the nation, and diverse demographic sectors of the work force. The breadth of coverage is illustrated by the attached listings of the eight witness panels and examples of the issues to be discussed by these panels.

Second, previous hearings have largely focused on the role of the Federal government in encouraging technological innovation to improve productivity. Witnesses at these earlier hearings have urged the Federal government to support various stages of the innovation cycle from basic research to technology transfer. In addition, they have recommended increasing government support of mathematics and science education, altering Federal tax incentives, and revising Federal patent policy to stimulate innovation and productivity. The Congress has already responded to many of these recommendations by passing appropriate legislation. There are, however, some pressing concerns beyond the stimulation of technical innovation and enhanced productivity. These concerns involve the impact of innovation and improved productivity on the nation's work force and consequently on the national economy. The connections between technology and the economic health of the nation must be thoroughly understood if the Federal government is to identify its proper role in addressing issues involving science and technology, employment, and international competition. For this reason, the planned hearings will examine government activities that can promote high employment and economic growth in an environment of continued technological development.

//

WITNESS PANELS FOR HEARINGS ON "TECHNOLOGY AND EMPLOYMENT"

Panel #1	Overall Perspectives and Trends (broad-based historical viewpoint)
Panel #2	Employment Projections (statistical projections in selected industrial sectors)
Panel #3	Demographics of Work Force (structural composition and characteristics)
Panel #4	Automation in Factory and Office (characteristics of changing workplace)
Panel #5	Quality of Workplace (social impact and behavioral aspects)
Panel #6	Training/Retraining (education, skills, and competencies)
Panel #7	Regional, State and Local Perspectives (policies and activities of state and local governments and organizations)
Panel #8	Future Perspectives (speculation on future trends and effects)

ISSUES TO BE CONSIDERED

BY WITNESS PANELS FOR HEARINGS ON

TECHNOLOGY AND EMPLOYMENT

Panel #1 -- Overall Perspective and Trends

1. What effects has the mechanization of work had on the economies of the United States and other industrialized nations over the past few decades?

2. How new are the problems we are facing? What parallels are there to the Industrial Revolution, for example?

3. What immediate and long-term changes in the work force and the workplace can we expect as a result of the accelerated pace of technological innovation?

4. What social and economic factors must be considered in determing the impact of technology on the work force? For example, are changing demographics of the work force, international competition, and a slow economy affecting the adjustment of the work force and workplace to technology?

5. Should government make technology a major consideration in its economic policies and planning? How and at what level of government should it be considered?

6. What effects of technology are there on income distribution and the valuation of work? Does it create greater class division? Who accumulates wealth in a technological society, and how do they use their wealth?

Panel #2 -- Employment Projections

1. What differences in the effects of technology on employment occur among traditional industries? Among emerging industries?

2. What job categories will show employment growth? Employment decline? How many workers will be affected?

3. In a world of rapidly changing technology, how reliable can we expect our employment projections to be?

4. Can technology bring the chronically unemployed into the work force, or does it add to the pool of chronically unemployed?

5. Do employment projections for the U.S. work force account for increased use of technology by other countries and subsequent competition in the world marketplace? Which U.S. industries and job categories will be affected by these international considerations?

6. What specific technologies and productivity improvements are these employment projections based on?

7. Will technology tend to create a dual society consisting of low-wage, low-skill service jobs on one hand and high-wage, high-skill professional jobs on the other?

8. To what extent can emerging industries create jobs to replace those lost in traditional industries?

Panel #3 -- Demographics of Work Force

1. What are the significant demographic changes occurring in the work force? How long will these changes continue?

2. What effects will these demographic changes have on the adjustment of the work force and workplace to technology?

3. Will some sectors of the work force experience long-term joblessness as a result of more technology in the workplace? Which sectors?

4. What special problems do certain sectors of the work force have in dealing with technology? Older workers? Blacks? Women? Hispanics? Younger workers? Uneducated workers? Recent Immigrants? Handicapped workers?

5. What kinds of jobs will increase or decline as a result of these demographic changes?

6. How can this demographic information be used in managing the adjustment of the workers and work environment to new technologies?

Panel #4 -- Automation in Factory and Office

1. What are some examples of the installation of new technology in factories and offices? What were the circumstances of installation and what were the results, both on employees and on companies?

2. Is there a greater incentive for automation in the office, as compared with the factory, because the largest share of office costs are labor related? What other differences between the office and factory environments would prompt a faster rate of automation in either the factory or office?

3. Does automation in the factory and office have special implications for some sectors of the work force, such as women in clerical positions and minorities in maintenance jobs?

4. Are factories moving away from traditional mass production techniques and towards flexible manufacturing systems which use automation technologies, such as industrial robots?

5. Given the current lead of large manufacturers and service organizations in automating factory and office, what is the outlook for automation in small firms?

6. What effects will automation have on established organizational structures in the factory and office? For example, will methods of communication and supervision be altered?

Panel #5 -- Quality of Workplace

1. What are some recent examples of efforts by management and labor to account for human factors in a technology-oriented work environment?

2. What incentives are there for the workplace to adjust to workers rather than solely expecting workers to accommodate technology in the work environment?

3. What effects will technology have on individual work assignments, including the range and variety of tasks, and responsibilities of the job?

4. How does technology in the workplace affect the social interaction of workers?

5. Does technology "dehumanize" workers, leaving them little control over their job performance and career objectives?

6. What kinds of special mental and physical health problems do workers face in an automated work environment?

7. How can we include human factors in planning and implementing automation in the workplace?

Panel #6 -- Training/Retraining

1. Does the rapid development of new technology for the work environment strain traditional approaches to job training and education such as vocational schools and universities? How?

2. Where are training and retraining programs currently needed in the national work force? Industries? Geographical locations? Occupations? Sectors of the work force?

3. What are the characteristics of these needed training and retraining programs?

4. Who should operate and pay for these training and retraining programs? Companies? Individuals? Government? Labor unions? Professional/trade organizations?

5. Should government be providing training/retraining incentives, such as grants, vouchers, and subsidies? What other alternatives are proper for government?

6. Is technology in the workplace leading to changes in the basic human skills needed by workers? For example, are employers placing more emphasis on formal knowledge, precision, and perceptual attitudes and less on manual dexterity and physical strength?

Panel #7 -- Regional, State and Local Perspectives

1. What are some examples of regions, such as Silicon Valley in California and Route 128 in Massachusetts, that have had strong employment as a result of high-technology industry? What factors have led to success in these areas?

2. How active a role are states and localities playing in bringing established industries up to date with new technology? In attracting new industries based on technology? Examples?

3. Is there a role for the Federal Government in these regional, state and local activities addressing employment and technology? What is the role?

4. To what extent can we expect technology to revitalize regions of the nation currently suffering significant unemployment?

5. What are the differences and similarities among these local initiatives to promote employment and technology? Are any of the initiatives appropriate at the national level?

6. What problems have arisen from efforts to focus on technology-oriented industries in regions where traditional industries have long dominated the work environment?

Panel #8 -- Future Perspectives

1. What is the general outlook for the national economy and employment in the next few years? By 1990?

2. Will new technological innovations bring more productivity improvements in the nation's industrial sectors? What kinds of innovations do you envision? Which industrial sectors will be significantly affected? What new jobs will be created?

3. Will the future role of government in managing technology and employment be different from its current role? In what ways?

4. What will be the future role of the financial community in supporting development of new technology and its application to the work environment? What types of investment will be needed to promote technology and jobs?

5. Will technology become even more of an international exchange commodity that affects jobs in the United States and our competitive status in the international marketplace?

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The Mechanization of Work

Introducing an issue on the continuing Industrial Revolution two centuries after it began. In the U.S. it has now displaced two-thirds of the labor force from the production of goods

by Eli Ginzberg

The easing of human labor by technology, a process that began in prehistory, is entering a new stage. The acceleration in the pace of technological innovation inaugurated by the Industrial Revolution has until recently resulted mainly in the displacement of human muscle power from the tasks of production. The current revolution in computer technology is causing an equally momentous social change: the expansion of information gathering and information processing as computers extend the reach of the human brain. This issue of *Scientific American* is devoted to the latest stage of the historic process that has led from the most elementary force-transmitting machines to the most advanced information-handling ones.

The transformation of the U.S. labor force in the country's brief history tracks the progressive mechanization of work that attended the evolution of the agrarian republic into an industrial world power. In 1820 more than 70 percent of the labor force worked on the farm. By 1900 fewer than 40 percent were engaged in agriculture. Half a century ago, when the capitalist societies were sliding into the Great Depression, more than half of the U.S. labor force had shifted from the production of goods to the provision of services. It was then, as large-scale unemployment destabilized those societies, that national policy began to look at employment as much from concern to ensure the consumption of goods as from concern to secure their production.

Today employment in the services in the U.S. is approaching the same 70 percent that were bound to the soil a century and a half ago. Only 32 percent of the labor force are still engaged in the production of goods (mostly in manufacturing), and a mere 3 percent are employed in agriculture.

Although this transformation has been brought about largely by mechanization, it has been accompanied by social trends so pervasive that they must be included among the causes of the transformation as well as among its effects. For example, although women had begun to enter the labor force from the beginning of the Industrial Revolution, by 1980 they had come to make up 43 percent of it [see "The Mechanization of Women's Work," by Joan Wallach Scott, page 166]. The age of entry into the labor force has risen, reflecting the desire of Americans for more education and the higher level of training required by jobs in the increasingly sophisticated economy as well as the release of human labor from the tasks of production. In 1940 the median number of years of school completed by the younger members of the population was 10.3; in 1980 it was 12.9.

A disquieting feature of these dynamic internal shifts in the labor force has been the persistence of high levels of unemployment among its less educated members. Such unemployment raises the question of how any society can function effectively over the long run without bringing all its adult members into its economic life, able not only to work but also to buy [see "The Distribution of Work and Income," by Wassily W. Leontief, page 188].

The five articles that follow take up the technologies of mechanization in five areas: agriculture, mining, design and manufacturing, commerce and office work. This introductory article will of necessity deal with a limited number of themes: how the mechanization of work has been treated by economists, what its effect has been on the U.S. economy over the past few decades and what its future effect is likely to be. Particular attention will be paid to the impact of mechanization on the shifting structure and character of the labor force and on the evolution of the work environment.

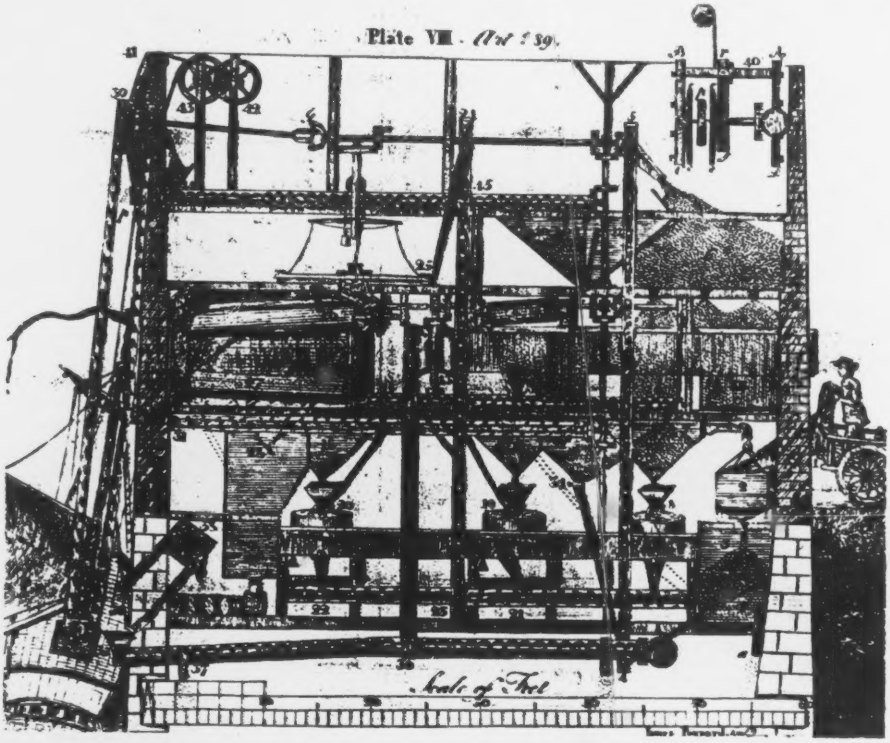
Adam Smith, in *An Inquiry into the Nature and Causes of the Wealth of Nations*, published in 1776, pointed to a basic dilemma: efficiency in the generation of wealth is enhanced by the division of labor, and yet specialization that involves nothing more than routine, repetitive tasks diminishes the worker by depriving him of intellectual challenge and decision-making responsibility. Smith, preoccupied with issues of moral philosophy, expressed his concern that many workers, in a desperate effort to improve their economic circumstances, would drive themselves so hard that it would affect their health and even shorten their lives. Smith's book was written before the commercial success of James Watt's steam engine, and so Smith never had to confront the full force of modern industrialization. He nonetheless appreciated the close links between the work men do and the quality of their lives.

David Ricardo, who began his study

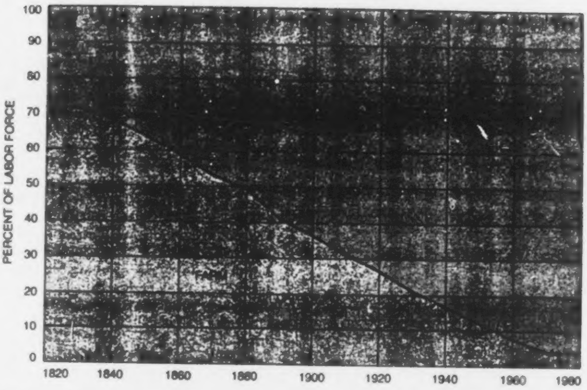
WORKERS AT A STEEL MILL in Pittsburgh were recorded by the noted documentary photographer and social reformer Lewis W. Hine in about 1910. Hine's revealing images of the adverse conditions of industrial labor in the early decades of this century were instrumental in the enactment of laws governing occupational safety and the employment of children. Much of the work being done by human muscle in this scene is now done by machine. The photograph, which is from the archives of the National Child Labor Committee, is now part of the Edward L. Bafford Photography Collection of the University of Maryland Baltimore County.

of political economy after reading *The Wealth of Nations* in 1799, went on to establish the classical, or free-market, school of economics. In spite of his almost exclusive emphasis on the competitive marketplace, he cautioned that increased reliance on mechanization might not turn out to be an unqualified blessing. He could see that under certain conditions workers displaced by machines might not be able to get new jobs. What was good for the employer, he concluded, might be bad for the worker.

Karl Marx devoted some of the most telling chapters in *Das Kapital* to describing the adverse effects of mechanization on the minds and bodies of working men, women and children in mid-19th-century Britain. (Because women and children received lower wages they were then replacing men in many branches of industry, from coal mines to textile mills.) According to Marx, the combination of machines,



MECHANICAL FLOUR MILL patented by Oliver Evans of Philadelphia in 1790 has been described as the world's first automatic factory and the forerunner of the modern continuous production line. This schematic diagram is from *The Young Mill-Wright and Miller's Guide*, published by Evans in 1795. The mill could be supplied with grain from either a boat or a wagon. In the latter case the wagoner dumped the grain into a spout (*1*), from which it flowed into a scale (*2*) for weighing before falling into a small garner, or granary (*3*). The grain was then led to a vertical bucket conveyor (*4, 5*), which raised it to the top floor. There a crane spout could deposit it in the main storage garner (*6*), from which it could be directed into a hanging garner (*7*) that in turn fed a millstone (*8*) for rubbing, or shelling, the grain before it was ground. The rubbed grain ran by a special channel (*broken lines*) back to the first garner, where the chaff was blown through a screen into an adjacent room (*9*). The grain was again elevated to the top floor, and the crane spout was turned this time over a pair of screen hoppers (*10, 11*), which fed a rolling screen (*12*). From there the grain descended through a current of wind made by a fan (*13*). The clean, heavy grain fell through a funnel (*14*) into a horizontal screw conveyor (*15, 16*), which distributed it uniformly to the three hanging garners (*7, 17, 18*), maintaining a constant flow of grain to the millstones (*8, 19, 20*). The ground meal was moved by another screw conveyor (*21, 22*) to a second bucket conveyor (*23, 24*), which emptied it into a rotary structure called the hopper boy (*25*); this device in turn spread the meal to cool it, sweeping it gradually through holes in the floor into a room called the bolting chest, where it was sifted by a set of rotating cloth sleeves called bolting reels (*26, 27*). The superfine flour collected in a packing chest (*28*) and was led out through a spout (*29*) to fill the barrels, which could then be loaded on the boat (*30*). The coarsely ground material was removed by another screw conveyor (*31*) to a garner (*32*), which also collected the light grain blown by the fan; the chaff was driven farther by the wind and fell into a separate chaff room (*33*). The coarse material was recycled by passing it through a gate (*34*) to the bottom of the first elevator. The grain supplied by boat could be unloaded from the hold by several methods: by an articulated screw conveyor (*35, 36, 37*), by a short bucket conveyor with a fixed upper pulley (*38*) or by a long external elevator (*39*) leading to the top floor. The pulley of the external elevator was designed to rise and fall in a pair of curved slots (*41*); the mechanism for hoisting the elevator clear of the boat (*42, 43*) is shown in another view (*40*). A screw conveyor on the top floor (*44, 45*) moved the grain into the mill. Evans finished the first model of his mill in 1783, and two years later a full-scale operating version was built at Red Clay Creek near Wilmington, Del. He promoted his invention vigorously, maintaining that his improved milling machinery "lessens the expense of attendance by at least one half."



HISTORIC DECLINE in the fraction of the U.S. labor force employed in agriculture reflects the high degree of mechanization achieved on the farm in the past century and a half. In recent years agriculture in the U.S. has actually become more mechanized than manufacturing.

private property and competition would soon result in the self-destruction of the capitalist system. The end would come, he said, when newer and more powerful machines would drive such a large proportion of the labor force out of work that producers would no longer have enough consumers to buy the goods their machines were turning out. With the advantage of hindsight one can now see that Marx was better as a critic than as a prophet. He correctly perceived that the Industrial Revolution was harming millions of working people, but he did not allow for the substantial gains in well-being they and the generations of workers after them would enjoy because of the increased productivity resulting from mechanization.

Thorstein Veblen made technology the basis for his own penetrating analysis of modern capitalism, from his first major work, *The Theory of the Leisure Class,* published in 1899, to his last, *Absentee Ownership and Business Enterprise in Recent Times,* published in 1923. Veblen consistently maintained that the way work is organized to suit the requirements of machines determines how men think, act and dream.

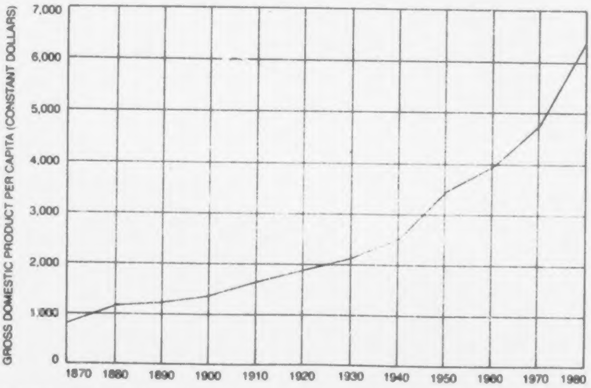
In general, however, most economists—free-market, Marxist or otherwise—have failed to give technology its due. The classical theorists and their successors have built their systems and their reputations by explicating with ever greater subtlety how demand, supply and price interact in competitive markets to establish or reestablish equilibrium. To pursue this static line of inquiry they have had to ignore the influence of such dynamic factors as changes in demography, technology and taste. Moreover, because they have a limited view of efficiency they search for the margin where it pays an employer to install machines to replace workers but seldom look into such factors as the quality of the workplace and the home, both of which have come increasingly under the influence of machines.

The shortcomings in the economists' approach to the mechanization of work can help to explain many of the errors in perception and action that have characterized the U.S. economy in the period since World War II. A better understanding of the complex relations between mechanization and the economic process can be gained by reviewing some of the more important of these misperceptions and the inadequate policies they have engendered.

In 1947 the U.S. instituted the Marshall Plan. If the countries of Western Europe—both the victors and the vanquished—could agree to work together, the U.S. promised to provide them with the capital needed to speed the rebuilding of their devastated economies. Within a few years the economies of Western Europe had turned around and were growing rapidly.

The success of the Marshall Plan had much to do with the inauguration of smaller-scale programs of economic assistance designed to accelerate the industrialization of the less developed countries. They too became the beneficiaries of American capital exports. Here, however, the record of accomplishment turned out to be much less impressive. Little of the so-called economic assistance went to economic development. Instead American capital exports often went in the form of arms and American dollars added to the personal wealth of those in power. Only in retrospect has it been possible to understand the reasons for the difference in outcomes. In Europe the war had destroyed factories, power plants, railroads and other facilities, but the knowledge required to run an industrial economy had remained intact. This knowledge, accumulated over a century or more, was drawn on to make good use of the new machines as soon as they were installed. In most of the Third World there was no such pool of experience, and as a result many of the imported machines were installed only after considerable delay; frequently they were operated far below capacity, and they were poorly maintained.

A second example of failure to bring



GROSS DOMESTIC PRODUCT of the U.S. has continued to rise at an approximately constant rate, when measured on a per capita basis. Nevertheless, there is considerable concern about the recent sharp decline in productivity, measured as a function of units of labor input.

mechanization into the center of economic policy is provided by the U.S. automobile industry. Until its recent troubles that industry was looked on as the bellwether of the American economy, proof that the U.S. was the technological leader among the developed nations. Year after year the industry's sales and profits were large, and although working conditions in the assembly plants were often unpleasant and arduous, the work force was well paid and received excellent benefits. The misperception of what was happening in Detroit resulted from a widespread failure to recognize that the industry's continuing high profitability rested primarily on styling, advertising and marketing, not on advances in engineering and in manufacturing technology.

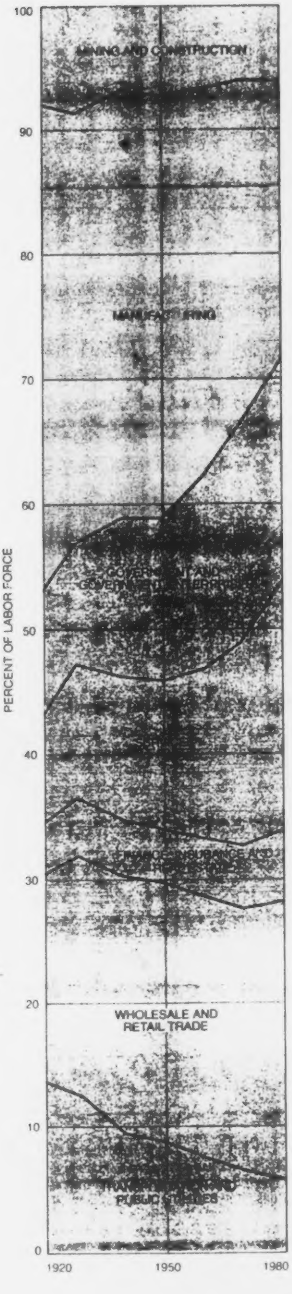
In 1962 Congress, convinced that mechanization was resulting in the disemployment of many skilled workers who would never be reabsorbed into the labor force unless they could be helped to acquire new skills, passed the Manpower Development and Training Act. That act, together with its successor legislation, the Comprehensive Employment and Training Act (CETA), passed in 1973, led to the expenditure of more than $80 billion up to the beginning of the Reagan Administration, mostly to help the poor and the near-poor. It is doubtful, however, that even 1 percent of the outlay was directed to the retraining and reemployment of workers who had lost their jobs through mechanization, because such workers could until recently make their own way into new jobs.

The most recent example of confusion about the mechanization of work arises from national economic policies ostensibly directed to "reindustrialization" (for example tax cuts for accelerated depreciation of plant and equipment, a measure expected to start a new boom in investment). The U.S. is urged to pursue other policies, public and private, that will putatively enable it to regain its eroding leadership in the manufacture of a wide range of industrial and consumer products, from steel to automobiles and television sets. Much is made of the superiority of Japanese management and the dangerous decline in the productivity of U.S. industry. However the issue is formulated, the core elements are the same: the leadership of the U.S. in technology has slipped, and there is a serious dysfunction in the attitudes, behavior and output of American workers.

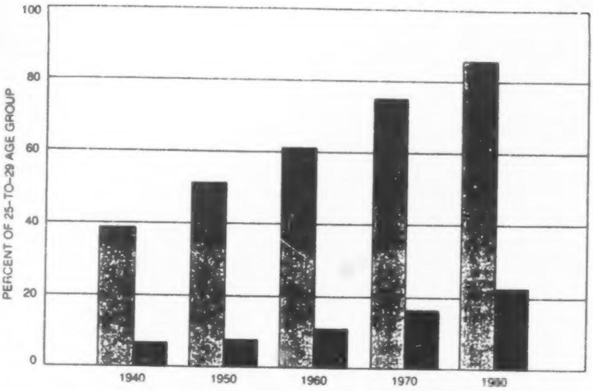
Actually the available statistics suggest that on a per capita basis the U.S. is close to its long-term trend in gross domestic product (G.D.P.): the output of all domestically produced goods and services. The unease centers on the recent sharp decline in productivity (measured as the ratio of total production to units of labor input). Any interpretation, however, is plagued by complications: the reported hours of work overstate the actual hours worked, exaggerating the measured declines in productivity; the U.S. economy has been shifting rapidly from goods to services, a shift that inadequately reflects the increases in output; the statistics also fail to adequately reflect changes in quality, investments in the public sector and what is happening outside the market, notably in the "underground economy" and in the household. If one were to understand and take proper account of these developments, the performance of the U.S. economy would probably be better, and possibly much better, than the current statistics suggest. Americans may well be unduly worried over a phenomenon that reveals more about the limitations of economic analysis and statistical reporting than about the economy itself.

The fact remains that mechanization has continued to play a leading role in the transformation of the U.S. economy and other developed economies in the past half century, as it did in the preceding century and a half. New and better machines have contributed to reducing the average weekly hours of work in manufacturing from 44 in 1930 to fewer than 42 today. At the same time mechanization has contributed to major gains in the rewards for work: the average pay in manufacturing has risen from $1.60 per hour then to $3 now (in constant 1967 dollars). This excludes fringe benefits, which have grown on the average to about 35 percent of base pay. Moreover, some economists have come to appreciate that the key to economic progress lies less with the accumulation of physical capital and more with the broadening and deepening of human capital, since it is human talent alone that is capable of inventing, adapting and maintaining machines.

Part of the problem is that the majority of economists, with their strong bias in favor of the competitive market, have paid inadequate attention to the contribution of the public sector to accelerating the growth of human capital. Public support has taken different forms: the



GROWTH OF THE SERVICE SECTOR of the U.S. economy is represented in color on this graph for the period 1920–80. The subcategories indicated cover all wage and salary workers (including full- and part-time workers) employed in nonagricultural establishments. Included are workers in the nonagricultural goods-producing sectors (manufacturing, mining and construction) and those in the service sector, defined in the broadest sense to encompass all enterprises not engaged in the production of goods. (The subcategory "Services" is narrowly defined to designate those workers who provide services primarily to consumers.) Excluded (besides farm workers) are proprietors, self-employed people, domestic servants and unpaid family workers.



EDUCATIONAL ATTAINMENT of the U.S. population has risen markedly in the past few decades. The colored bars indicate those in the 25-to-29 age group who have finished four years of high school; the gray bars correspond to those who have been graduated from college. Between 1940 and 1980 the median number of school years completed rose from 10.3 to 12.9.

"G.I. Bill of Rights" of 1944, the expansion of public higher education, Federal financing of research and development, and the large-scale proliferation of specialized training programs created as by-products of efforts to build up the country's military strength and to develop nuclear power, aircraft, computers, spacecraft, communications and other large-scale technologies.

In the three decades between the election of President Eisenhower and the election of President Reagan both per capita disposable income and family income, expressed in constant dollars, almost doubled. Trade unions have become a prominent feature of the industrial landscape (although their membership as a fraction of the total work force has declined since 1955), and a professional, college-trained cadre of managers has taken command of most U.S. corporations. It would be surprising indeed if, mechanization aside, the foregoing changes had not left their mark on how workers behave both on the job and off it.

Other factors must also be taken into account: the repeated involvement of the country in foreign wars, the growing threat of nuclear war, rapid changes in basic values and behavior involving aspects of life from sex to religion, increasing skepticism about and challenges to authority and legitimacy. Only those economists who believe everything in life is determined by the calculus of the marketplace would attempt to explain the difficulties in which the U.S. economy finds itself in 1982 as resulting from a collapse of the work ethic. The Luddites looked on the machine as the villain; the supply-siders blame the worker.

The second of the three themes I mentioned at the outset is the extent to which mechanization has helped to change the U.S. economy since World War II. Of the 41.6 million people employed in 1940 (excluding the self-employed and domestic servants) 54 percent were engaged in the production of goods: in agriculture, mining, construction and manufacturing. Mechanization had earlier made steady advances in the grain-producing states of the Middle West, but it had only a minor place in the cotton culture of the Southeast. The South, in the view of President Roosevelt, was the nation's No. 1 economic problem. It conformed to the Marxian view that surplus labor would be concentrated on the farm, living at the margin of subsistence and awaiting an opportunity to relocate to urban centers when employers needed additional workers. As late as 1940 four out of five black citizens were still living in the South, the majority of them on farms they sharecropped.

World War II was the continental divide. Many blacks went into the armed services; others moved to the North and West, where employers faced growing labor shortages; still others moved into Southern cities, many of which were being transformed by the infusion of military dollars. Other farming areas also sustained a large-scale exodus of surplus labor, setting the stage for the accelerated mechanization of agriculture. Paradoxical as it may seem, agriculture is now considerably more mechanized than manufacturing.

In the same four decades mechanization made rapid advances in bituminous coal mining as a result of two factors: the development of strip mining in the West and the decision of the United Mine Workers' Union, led by John L. Lewis, to favor higher wages over more jobs. In spite of the widespread belief that strong unions have inhibited mechanization in the construction industry, the evidence from the mechanization of excavation to the prefabrication of structures points to major advances in the application of sophisticated technologies. Although some construction unions have been strong enough to delay the introduction of new machines or to prevent the new machines from operating at full capacity, these delaying tactics have in certain instances stimulated the growth of nonunionized industry, where contractors were able to mechanize without interference.

At the height of the war boom the goods-producing sectors of the U.S. economy accounted for 69 percent of the employed labor force. In 1980 they accounted for 32 percent. The most striking shift in the goods-producing sectors was the decrease in the number, both absolute and relative, of agricultural workers. The second most prominent shift was the relative decline in manufacturing, where employment increased from 34 percent of all nonagricultural jobs in 1940 to 41 percent in 1943 but declined to 22 percent at present.

The decreasing employment in the goods-producing sectors of the economy was first matched and then exceeded by the increasing employment in the service sector. Between 1940 and 1980 employment in service occupations grew from 46 percent of total employment to 68 percent. Of all new jobs added to the economy from 1969 to 1976, 90 percent were in services.

What are the reasons for this shift? The answers differ depending on who is asked. Some economists deny that a significant shift has occurred; at most they will agree that there has been a slow, steady growth of service-sector jobs. Some acknowledge that a shift has occurred, but they ascribe it primarily to the explosive growth in health, education and related services. They expect that the growth will level off and even decline now that the birthrate is down and the Reagan Administration is pressing to reduce the level of Government outlays. Others, including our own group at Columbia University, are convinced that there has been a tilt of demand toward more consumer services and that, even more important, changes have been made in the way goods are produced, calling for a vast expansion in "producer services." Thomas M. Stanback, Jr., and his colleagues at Columbia, in their recent book *Services/The New Economy*, note that the value added of producer services alone—financial, legal, accounting, marketing, management consulting and communications—

equals the value added of all manufacturing output.

A look at the changes in the occupational structure further illuminates the causes and consequences of the shifts identified here. Somewhat simplistic comparisons can be made among white-collar workers, blue-collar workers and service-sector workers (narrowly defined as those who provide services primarily to consumers). In 1940 the proportions employed in these kinds of occupation were respectively 31 percent, 57 percent and 12 percent; in 1980 they were 54 percent, 34 percent and 12 percent. Bigger and better machines on the farm, in the mines, in the factory and at construction sites call for fewer operatives. In modern oil refineries, chemical plants and steel-fabricating mills there is a great deal of machinery but there are few workers, and many of the workers are engaged in white-collar jobs. The General Electric Company, which manufactures tens of thousands of different items from turbines to electric-light bulbs, has no more than 40 percent of its employees directly engaged in production; the rest work in what can best be classified as in-house producer services from accounting to marketing.

If one looks at the qualitative changes that are suggested by the shift from blue-collar to white-collar employment, one finds a truly impressive growth in the two groupings in the standard categories of the Bureau of Labor Statistics that have the highest status and incomes: professional, scientific and technical workers, and managerial and administrative workers. Between 1940 and 1980 the former group increased from 7.5 to 16 percent of the employed labor force, and the latter group declined from 20 to 13 percent. The last two figures conceal a major qualitative transformation, since they lump the owners and managers of small enterprises, whose numbers declined, and corporate and other high-level administrators, whose numbers rose.

Confirmation of the radical changes in the occupational structure can be found in the striking rise in the educational achievements of the younger members of the work force: those between 25 and 29 years of age. One need not hold the philistine view of many human-capital theorists that educational preparation is determined solely by the estimates people make of their career and income prospects to see that the two factors are definitely correlated. The large increase in the proportion of those in the 25-to-29 age group who have either an undergraduate degree or a higher degree is striking: from one in 16 in 1940 to almost one in four in 1980.

There is a bias among economists going back to Adam Smith that only work resulting in a physical output is productive and that services, which are by their nature ephemeral, are unproductive. Smith, reacting to the excessive number of family retainers among the rich, misled himself and his followers about the nature of services. Economists finally realized, however, that an artist who gives pleasure to thousands or a surgeon who restores the health of hundreds must be considered productive. Nevertheless, the followers of Smith have been preoccupied with refining the manufacturing model. With few exceptions the output of services has been downgraded or ignored.

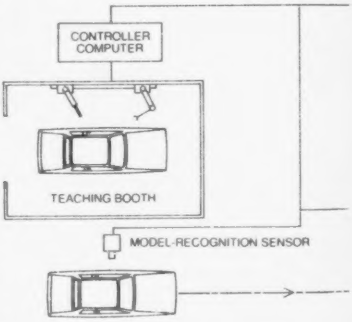
This bias against service occupations was reinforced by a widespread belief that mechanization, the key to productivity and growth, has little or no role to play in the production of services. In fact, some contemporary economists have separated out the heavy, capital-intensive services—transportation, communications and electric-power utilities—and treated them as either part of or closely related to conventional manufacturing.

A further bias has been at work. Many services are anchored in the public sector rather than the private sector; the leading examples are education, health and such basic functions as police protection, fire protection and sanitation. Economic theory based on the competitive marketplace has little to contribute to an understanding of such public services. Handicapped by tradition, economists have been slow to understand the shift of modern economies toward services and in particular toward services in the public sector, toward producer services and toward mechanization in large service enterprises.

Most economists assumed that service companies would inevitably continue to be small, since service providers had to interact personally with consumers, as in the case of a restaurant, a dry-cleaning establishment, a physician or an accountant. The model of the small local consumer-service company, however, clearly does not fit the fast-food chains, the international banks with branches in 100 or more cities, the worldwide hotel chains, the national retailing chains and many other national and international service enterprises that have been able to mechanize many of their critical functions, from finance to personnel management.

As I have noted, the period since World War II has also been marked by a steady advance in the educational preparation and skill level of the work force, as exemplified by the increase in the number of white-collar workers and of professional, scientific and technical workers. The question remains of whether it is more difficult in the service sector than it is in the manufacturing sector to move from a less desirable job to a more desirable one. Stanback believes this has been the case. He points to the steelworker who began work in the yard and could move up many grades on the basis of seniority and on-the-job training. That is not the case, he observes, for the laboratory technician in a hospital or the paralegal worker in a law firm. In support of this argument, it has to be conceded that a college or professional degree is a prerequisite for competing for many of the best jobs in the service sector. On the other hand, talent appears to be as important as formal degrees in many occupations, such as advertising, design and sports. In my view the issue remains open.

These last considerations are a bridge to the third theme I mentioned at the outset: the effects of mechanization on the work environment. To the extent that any generalization is justified, one can maintain that the conventional attitude of the American worker toward machines has been different from that of

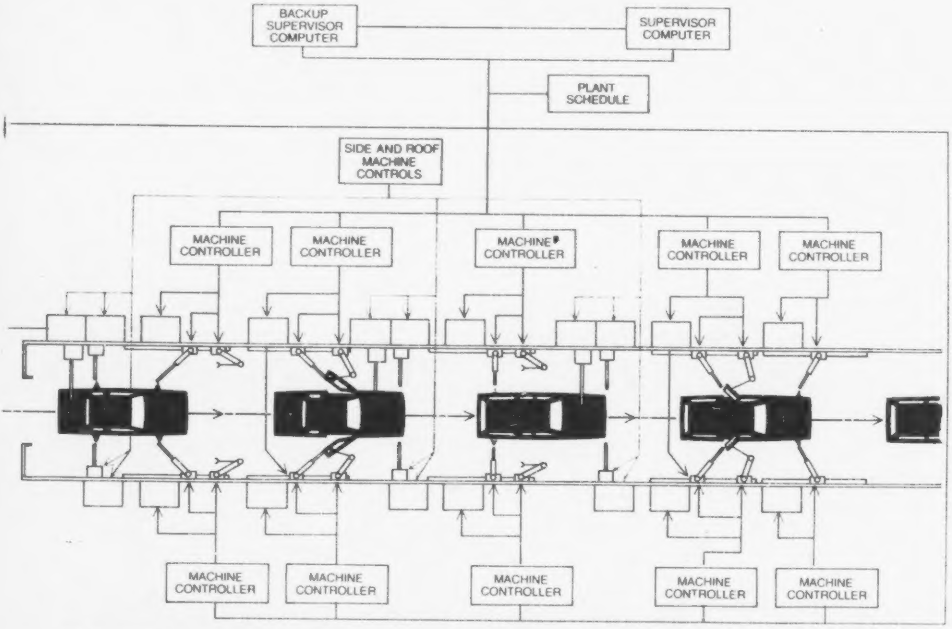


TOTAL MECHANIZATION of a new system for the spray painting of the bodies of cars and light trucks makes it possible to remove all human workers from a particularly onerous industrial task. The diagram shows the control hierarchy for the Numerically Controlled Paint System, which has been developed over the past seven years by the General Motors Corporation; the system has recently been installed at the GM assembly plant in Doraville, Ga. The present system consists of three pairs of automatic, fixed-stroke, roof the European worker. For the most part American workers have had a positive attitude toward technological improvements, seeing them as making their work less onerous and as providing an opportunity for wage increases through increased productivity and for the enhancement of their job security through improvement of their company's competitive position.

In European countries, with their smaller markets, the job-displacement potential of the new machines has been more prominent in the thinking and action of the workers. Technological unemployment was viewed as a serious threat by the principal unions in the German Weimar Republic of the 1920's, and even the economic revival of West Germany after World War II did not dispel this fear. In the early 1960's the largest of the West German unions, the metalworkers, were host to a week-long international conference on mechanization and the involuntary unemployment it could cause. The issue is once again high on the agenda of the West German trade unions, particularly because of the disturbingly high level of unemployment in that country.

Marx railed against the dehumanization of work in which the machine set the pace, a theme that was resurrected in succeeding generations by John Ruskin, Edward Bellamy and Emma Goldman and that was developed perhaps most imaginatively in Charlie Chaplin's motion picture *Modern Times*. One need not gloss over the physical and psychological strain of working on the assembly line to point out that at the peak probably no more than one in 15 or 20 American workers earned a livelihood by such work. Robert Schrank, whose *Ten Thousand Working Days* is the most perceptive account of the diversity of working environments in the contemporary U.S. economy, makes a strong opposing case. Instead of the machine's dominating the lives of the workers, he writes, the immediate work group learns to organize its activities to enlarge its scope of freedom to do the things its members most enjoy: swap stories, fool around, play games, gamble, keep the foreman off their back and otherwise interact with one another, investing little of themselves in carrying out their assignment.

Three decades ago, in the book *Occupational Choice*, my coauthors and I distinguished three returns from work: intrinsic (direct work satisfaction), extrinsic (wages and benefits) and concomitant (interpersonal relations on the job and in the work environment). Advocates of improving the quality of work life see major opportunities to enhance the intrinsic and concomitant returns that workers are able to get from



and side sprayers of a type already in wide use for such painting operations, five pairs of numerically controlled paint machines (four pairs equipped with door-opening devices) and an off-line teaching booth that houses another numerically controlled painter with its associated door opener. (The number of painting stations is expected to vary from plant to plant; one system currently being installed has 18 of the new machines.) The numerically controlled painter is a seven-axis device, hydraulically driven and servomechanically controlled. Its function is to paint all external body surfaces and various internal surfaces not covered by the roof and side sprayers. The machine's reach enables it to paint bodies of all sizes, ranging from subcompacts to full-size sedans, station wagons and pickup trucks. The painter's companion, the door opener, has two servo-controlled axes and one pneumatic axis. The supervisor computer tracks each car body through the painting booth and sends the correct path data to each machine controller at the proper time. A body-recognition system identifies each body as it enters the painting booth. The recorded information is sent to the supervisor computer and is checked against the plant schedule to determine the car's color and other options. In order to "teach" the painter a new routine a worker in the off-line teaching booth grasps a handle attached to the end of the teaching painter's arm and leads the spray guns through the appropriate paint paths, recording positions along the way and signaling "on" and "off" points. The resulting data are then stored in the system's computer.

their work. In my opinion they exaggerate. The scope for decision making by workers on the factory floor or in the large office is severely limited. An extreme division of labor results, as Smith perceived, in routine, repetitive tasks from which decision-making functions have been extracted.

Although American trade unions may have been too confrontational in their attitudes, their underlying conviction is that, beyond pressuring management to make the work environment safer, cleaner and more attractive, there is not much management can do to improve the intrinsic rewards from work. Accordingly unions have pressed and will continue to press for improvements in extrinsic rewards: job security, equity in selection for promotions, participation by the unions in discipline and discharge, better wages and fringe benefits, and more free time.

As my colleagues Ivar Berg, Marcia Freedman and Michael Freeman have documented in their book *Managers and Work Reform*, much of the agitation of the U.S. economy is a function of the expectations workers have about their jobs; there is a real danger that many are overeducated for the work to which they are assigned. Furthermore, much of the dissatisfaction of workers stems not from their limited scope to participate in decisions that affect their work but from their frustration with managers who fail to perform effectively.

Much of the preceding discussion of the workplace, worker motivation and the quality of work life has been in terms of the modern factory. Since the labor force is now overwhelmingly employed in the service sector, however, it seems desirable to call attention to a few future developments in the relation of mechanization to the work environment there.

Because of the critical importance of quality in the service sector the control of work and workers confronts management with a new and difficult challenge. Service-sector work has more dimensions and complexities than factory work, particularly considering the much higher proportion of professional, scientific and technical people employed in service industries. It is the hallmark of such personnel that their training has conditioned them to decide what work to do, how to do it and even when to do it. The members of a university faculty, although they are members of a department, a school and a larger institution, consider themselves as self-directed, autonomous individuals to whom the chairman, the dean and the president can address requests but not give orders. Increasingly this academic model is spreading to industry and government, to the research laboratories, to corporate staffs and to government agencies. There is growing tension between the traditional hierarchical structure of organizations and the implicit (and increasingly explicit) demands of professionals for greater autonomy in their work. How these demands will be reconciled with traditional modes of management remains to be seen, and the process of reconciliation may prove as difficult as it is important.

At the other end of the occupational scale it appears that the increase in the number of service-sector jobs has been correlated with the decrease in the fraction of the work force that is unionized. Many observers believe trade unions will be further weakened as the growth of the service sector continues. This may in fact happen, but several countervailing factors must be considered. Many service jobs pay low wages and provide limited benefits. More women, concentrated in low-paying service jobs, are becoming regularly attached to the work force. The computer revolution seems ready to make major inroads into the office, a development that holds a threat to the job security of many white-collar workers. The continuing erosion of the real earnings of workers by inflation makes these employees receptive to union organization. It is easy to write off the trade-union movement, particularly since it has had a conspicuous lack of success so far in restructuring itself to meet the challenges of a changing economy. Even if the unions finally succeed in making sizable gains in the service sector, they will face not only the conventional challenges of achieving higher wages and better fringe benefits for their members but also the challenge of contributing to a more stimulating workplace.

Veblen once explained the success of Germany in overtaking Britain as an industrial power in terms of the advantages of being second (or third). The latecomer did not have to carry the burden of obsolescent machinery or business practices. Many analysts in the U.S. in 1982 think Japan and the leading nations of the Third World have the same advantages Germany once had. The analogy is suggestive, but it is faulty. For some years various manufacturing activities have been moving to low-wage countries not only out of Western Europe and the U.S. but also out of Japan.

There is widespread concern about the periodic imbalances of U.S. trade in commodities with the rest of the world. In 1980 the deficit in such trade amounted to slightly more than $25 billion. That is not the whole story, however. Fees and royalties on direct U.S. investments abroad amounted to almost $6.7 billion, and net earnings on foreign investments, excluding these fees, came to $32.8 billion, resulting in a net surplus of more than $13 billion in goods and services (adjusting for the small net deficit in travel receipts). Goods and services do not lead totally independent existences, and as I have noted, services have come to play a much more important role in the production of goods. The challenge to the U.S. economy is not "reindustrialization" but rather "revitalization," in which mechanization has an important role to play with respect to both goods and services.

It is moot whether any new specific policies are required to speed revitalization beyond a recognition that the U.S. economy is moving ever more strongly into services and that the country's legislators and administrators should deal equitably between the different sectors in the creation and implementation of trade, tax and employment policies. The Reagan Administration, through the Office of the Special Representative for Trade Negotiations, has demonstrated a growing concern with international trade involving services. In the private sector a recently established consortium of major service companies is further evidence of attention and action.

A conclusion that government should not venture into the formulation of industrial policy does not imply that the state has no role to play in the strengthening of the industrial infrastructure. It is important to remember that government has played a major role in leading American industries: in agriculture, aeronautics, nuclear power, electronics, computers, communications, genetic engineering and other emerging technologies. If the present Administration has its way, the support of universities, the education and training of specialists and the underwriting of research and development will not be carried forward at an appropriate scale or with the adequate lead times. The machines that are invented, improved and put into operation throughout the economy depend on a steady accretion in the pool of knowledge and on the availability of enough technicians. If the country had to wait for the big corporations to train their own technical personnel from the ground up, it could wait a long time. Even if they wanted to do it, they could not. The ideologues may swoon over the beatitudes of the competitive market, which clearly has much to commend it, but the U.S. economy, for better or worse, is a pluralistic system in which government, nonprofit institutions and privately owned companies have complementary relations. No one of them, left to its own devices, can prosper in a technologically sophisticated world.

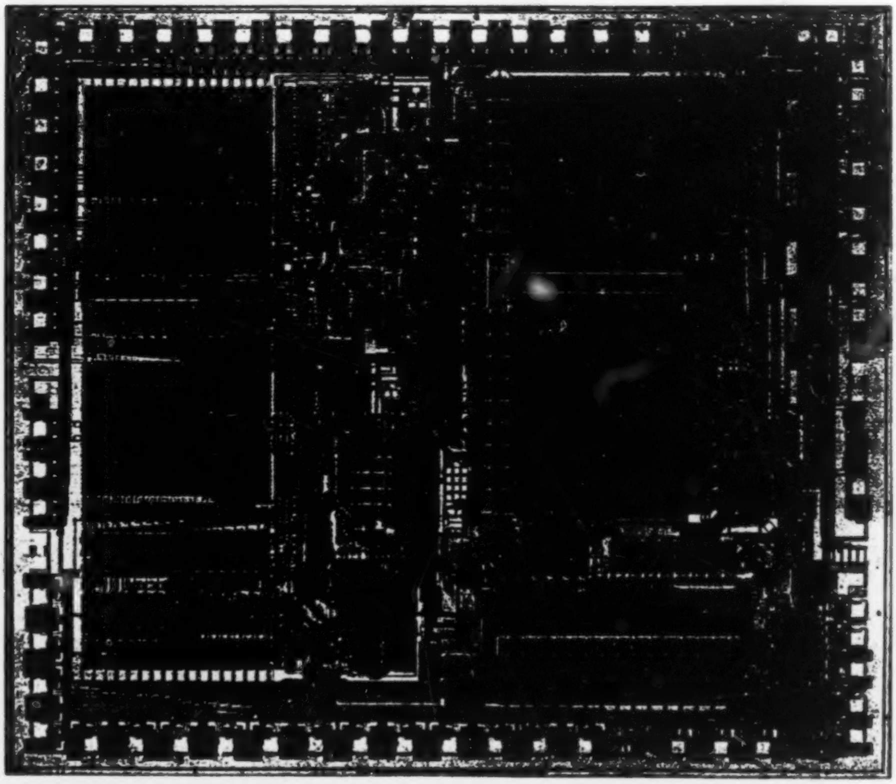
It would be a distortion to end this introduction to a series of articles on the mechanization of work without consideration of its problematical consequences. I shall therefore take up some of the consequences of mechanization for women and for the undereducated.

With respect to women, mechanization unquestionably paved the way for many of them to escape the confines of the home as a result of laborsaving devices, which eased the chores of housekeeping and, equally important, reduced the role of physical strength as a qualifying characteristic for many jobs. The positive role of mechanization in the liberation of women had little or no influence, however, on such untoward trends as the ominous rise in the number of households headed by women, the disturbingly large number of youngsters being brought up solely by their mothers and the large fraction of those families that live at or below the poverty level. These trends can be disregarded only by a society that is indifferent to human deprivation and unconcerned about its own future.

Before the introduction of sophisticated machinery as well as afterward all economies have faced difficulties in providing jobs for everyone who needs work. In spite of the good record of the U.S. economy with respect to the creation of jobs in recent decades Arthur F. Burns, the former chairman of the Board of Governors of the Federal Reserve System (and the current U.S. ambassador to West Germany), recommended in 1975, in the face of the continuing difficulties that many young people were having in finding and keeping jobs, that the Federal Government become "the employer of last resort" at wages 10 percent below the legal minimum wage. Some believe the shift of the economy toward services is currently making it more difficult for the undereducated to find a niche. An increasingly white-collar economy has no place for functional illiterates.

I have one concluding observation about the relation between mechanization and work. There is a widespread belief in the U.S. and Western Europe that young people have a smaller commitment to work and a career than their parents and grandparents had and that the source of the change lies in the collapse of the "work ethic." The question of why the work ethic collapsed is seldom raised, although sophisticated analysts suggest it is linked to economic affluence and the shift of concern from the family to the self.

I would suggest that the success of modern technology, which has put each of the superpowers in a position to destroy the other (and much of the rest of the world), presents a basic challenge, not only with respect to work but also with respect to all human values. It remains to be seen whether or not the potential of modern technology will turn out to be a blessing. Many young people are betting against such an outcome, and others are waiting before committing their modest stake.



MICROPROCESSOR at the heart of the graphics computer shown in the painting on the cover crowds some 70,000 transistor sites onto a single chip of silicon measuring roughly a fourth of an inch on a side. The chip, designated the MC68000, is the first in a projected family of integrated 16-bit microprocessors developed by Motorola, Inc. The dark areas at upper right are the system's memory elements.

Impact of new electronic technology

RICHARD W. RICHE

The steady stream of technological progress that has characterized our society in America has resulted in higher productivity, elimination of many menial and dangerous jobs, higher wages and shorter hours, and a continuous flow of new products and services which have resulted in a higher standard of living. New industries employing thousands of workers have been formed to manufacture computers, electronic products, and technologies to provide energy and control the environment.

To be sure, innovation in industries such as longshoring, agriculture, and printing, to name a few, has eliminated jobs and required workers to acquire the unfamiliar skills associated with new technology. For some, the adjustment has been painful. But on balance, there is general agreement that the benefits of new technology far outweigh the disadvantages, and that innovation has led to economic progress, new job opportunities, and a more prosperous society.

At this point, early in the decade of the 1980's, there is widespread agreement that the pace of diffusion of technologies which incorporate advanced electronics will be accelerated over the next few years. The experience in the United States suggests that as long as the economy is growing, the introduction of innovations with potential for productivity gains can be compatible with rising employment. When computers were first introduced for office data applications, for example, frequently predictions were made that large numbers of clerical and kindred workers would be displaced and that job opportunities for millions would be curtailed. What actually did happen was quite different. In 1960, clerical workers in the United States numbered about 10 million and accounted for about 15 percent of total employment. By 1980, there were more than 18 million clerical workers and they accounted for about 19 percent of the total. Thus, instead of decreasing as had been predicted, clerical employment increased about 85 percent. And, it is projected to grow significantly to 1990.

Why did clerical employment increase instead of decreasing as predicted? First, normal growth in the volume of clerical work exceeded jobs eliminated by the computer. Second, computers made possible work that was previously impractical because it would have been too costly and too time consuming. Using computers, managers can now prepare reports and analyses that previously were desirable but too costly.

In addition to creating employment by expanding the scope of activities for many industries, the computer required new occupations such as systems analysts, programmers, keypunch operators, console operators, and tape librarians. And new industries were established to manufacture computers and related equipment, creating a variety of occupations and employing thousands.

Technological change can cause job displacement, especially when the industry is concentrated in a particular region or locality. Sometimes the employment impact is direct, as in the case of agriculture. In most cases, however, the effect is less obvious. Output does not advance at the same rate as productivity in all industries or plants, and consequently some industries register employment declines while others register increases. Regardless of the reason, displacements are costly for both the individual and the Nation.

This report examines four major technological changes under way in the United States and discusses prospects for their further diffusion. The four areas are microelectronics, industrial robots, telecommunications, and office automation.

The development of *microprocessors and microcomputers* in the early 1970's, and their widespread diffusion as we enter the 1980's, is a major innovation in electronics. Over the past three decades, the transistor that replaced the bulky vacuum tube was a first step in the development of miniaturized semiconductor integrated circuits which provide more power and reliability in a significantly smaller package. A microprocessor unit contains thousands of electronic components and complex circuits on a silicon chip less than one centimeter square. The unit can be combined with memory and input-output capability to build a microcomputer.

The use of microelectronics has had a significant im-

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pact on American consumers, workers, and manufacturing operations. A vast array of products—calculators, digital watches, video games, TV sets, and microwave ovens, to name a few—incorporate microprocessors and microcomputers. But behind the scenes in American manufacturing plants, production technologies and manufacturing methods are undergoing equally dramatic changes. Microelectronics are being incorporated in systems which control key production equipment, such as industrial robots and numerically-controlled machine tools. Moreover, microelectronic devices increase the processing capability of word processors, computers, data transmission and copying devices, automatic checkout counters, and other such equipment used by banks, insurance companies, and retail and wholesale establishments.

The *industrial robot* is a second major technological innovation capturing current attention. The Robot Institute of America defines a robot as "a reprogrammable multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks." According to the institute, about 4,000 robots are in use in U.S. establishments, with a large share in automobile manufacturing plants. They perform tasks such as material transfer, die casting, spot welding, spray painting, and limited assembly. Although U.S. industry is increasing its use of robots, Japan leads the world in robot use with more than triple the number of installations in the United States.

There is little information on the impact of robots on productivity and employment. However, evidence suggests that, following installation of robots, productivity is increased, unit labor requirements frequently are lowered, and quality control is improved. At one large manufacturer of refrigerators, for example, a robot sprays paint on refrigerator liners twice as fast as the two-person crew that it replaced.[1] The future impact of robots on productivity and employment will depend on the extent of development and diffusion of new generations of robots that can "see and feel."

Technological changes in *telecommunications* are underway in all major segments of the industry. These innovations are boosting productivity and changing the type of labor required in the two basic processes of telephone communication—call switching and signal transmission. The electronic computer is used extensively in both processes, as well as in other operational tasks and in management and accounting functions.

In call switching, electronic switching systems use high speed computers to handle local and long-distance calls. A growing share of calls is handled by electronic switching systems; total conversion is anticipated by the year 2000. These systems can handle three to four times more calls than electromechanical systems.

Sharp gains in long-distance volume have led to two innovative and important technologies in signal transmission—the millimeter waveguide and fiber optic cables. Both have far greater call-handling capabilities than the existing coaxial cables and microwave relays. The millimeter waveguide is essentially an underground tube through which signal-carrying waves are transmitted. It is designed for use on high density communication routes. Currently, this technology is being tested; future diffusion will depend on call volume growth.

Fiber optic cables for signal transmission are expected to become a major transmission medium in the 1980's. In this technology, glass fiber cables are combined with semiconductor light sources for very high capacity transmission. The fiber cables are compact, resist electrical interference, and interface well with digital switching and transmission techniques.

Other major changes anticipated for the telecommunications industry include further expansion of satellite communication, digital transmission, computerized systems for maintenance and testing, and automation of switching and billing tasks. Experts also foresee nontraditional uses of the communications network for electronic funds transfer in banking, electronic postal service functions, and data systems for the home which will combine communications and data processing capabilities.

Office *data handling and communication* is a fourth area where major technological change has occurred. A large segment of the Nation's work force, including more than 18 million clerical workers, is engaged in producing and processing data. Historically, capital investment in the office has lagged that of other operations, with investment per office worker amounting to less than $2,000, compared with about $25,000 per factory worker.[2]

This "investment gap" may be closed in the years ahead. Investment in office technologies will likely accelerate during the 1980's, as managers turn to modern data handling technologies to reduce labor, material, and related expenses. The largest share of office costs are deemed to be labor-related—a strong incentive for further mechanization.

Specific technologies to be diffused more widely include more powerful electronic computers; advanced model word processors; new equipment and techniques to store, retrieve, and transmit data on microfilm; and electronic mail networks. Increasingly, paper will be replaced by electronic images on a screen which can be transmitted by telecommunication methods.

General impact of innovations

Following are conclusions from the Bureau of Labor Statistics' research on the implications of technological change for the work force.

- While all industries are experiencing technological change, the pace varies among and within industries. Each industry has its own story and it is not always in terms of computer technology and advanced automation. But even conventional changes, such as materials handling mechanization or the installation of larger capacity equipment or machines with faster speeds, are often major developments requiring workers to obtain new skills.
- The size of investment required, the rate of capacity utilization, and institutional arrangements are some of the factors that act as an "economic governor" on the speed of diffusion of technological change and, in turn, possible employment implications.
- Industries with greater application of technological advances generally experience larger increases in productivity (examples, air transportation and telephone communication); industries lagging in application of technological advances generally experience smaller or negative changes in productivity (examples, footwear and wood household furniture).
- The content of jobs and the qualities required of workers are being modified by technological changes. There is less demand for manual dexterity, physical strength for material handling, and for traditional craftsmanship. In contrast, employers are placing more emphasis on formal knowledge, precision, and perceptual aptitudes. As many manual tasks are mechanized, unskilled workers become monitors of very expensive equipment. The reduction in repetitive tasks that are so dissatisfying to the industrial worker may be welcomed, but the isolation and constant monitoring associated with advanced technology can create new stresses.
- Higher educational achievement of workers is becoming essential. The ability to read and write at a functional level is mandatory to interpret operating instructions of complex equipment, and to be retrained for the new skills demanded by changing technology.
- Many new occupations created by new technologies can be filled by retraining employees. Most retraining is accomplished in-plant and includes on-the-job and classroom instruction.
- In general, relatively few employees have been laid off because of technological change. This is due, in part, to the use of various techniques by the private sector to minimize adverse effects to the worker—techniques such as providing advance notice, retraining, and reassigning displaced employees to new jobs. ☐

——— *FOOTNOTES* ———

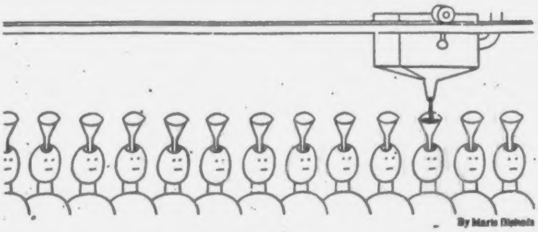
[1] "Robots Join the Labor Force," *Business Week*, June 9, 1980, pp. 62–76.

[2] Philip H. Dorn, "The Automated Office—The Road to Disaster?" *Datamation*, Nov. 15, 1978, pp. 154–62.

High-Tech Requires Few Brains

The jobs being created will demand less skill, not more

By Henry M. Levin
and Russell W. Rumberger



By Marie [illegible]

MUCH IS BEING MADE of our arrival into the age of high-technology. In Massachusetts last week, President Reagan declared the country is "in a great transition" to high tech, furthing the notion that the nation's economic ills will be cured by our new sweetheart industry as it spawns massive numbers of new jobs requiring sophisticated mathematical and engineering training while reducing or even eliminating opportunities for the unskilled.

Well, the evidence suggests it isn't going to work that way.

High tech is neither the place where most new jobs will be found nor will high tech require a vast upgrading of the skills of the American labor force. To the contrary, the expansion of the lowest-skill jobs in the American economy will vastly outstrip the growth of high-technology ones. And the proliferation of high-technology industries and their products is far more likely to reduce the skill requirements for jobs in the U.S. economy than to upgrade them.

Last year the Labor Department did project that in the '80s, jobs for computer programmers would grow between 74 and 148 percent while overall job growth would only be 22 percent.

But the percentages are misleading. The total number of new jobs for computer programmers is expected to be 150,000. Some 1.3 million new jobs are projected for janitors, nurses' aides and orderlies. That's nine unskilled jobs in these categories alone for every computer programmer. In fact, no high-tech job even makes the Labor Department's top 20 in terms of total numbers of jobs added to the U.S. economy.

New jobs for data-processing-machine mechanics will increase 148 percent, the fastest growing job category. But that large gain translates into an increase of less than 100,000 new jobs, while 800,000 new jobs are projected for fast-food workers and kitchen helpers alone.

Of course, occasional shortages of skilled workers will arise in particular occupations and industries as they have occurred historically. Both the economy and educational system will have to make specific adjustments to alleviate them. But that is hardly the general shortage of skilled workers projected by those who have exaggerated the effects of high-tech.

Neither will the high-tech transformation of existing jobs create demands for increasingly sophisticated work skills. Secretaries will work with word processing equipment; bookkeepers will use computerized, financial spread sheets; purchasing and inventory clerks will apply computerized record systems; mechanics will use diagnostic equipment employing minicomputers; telephone operators will rely on computerized directories.

But there is little evidence that these jobs will require workers with more sophisticated skills. To the contrary, studies suggest that the new technologies provide opportunities to further simplify and routinize work tasks and to reduce the opportunities for worker individuality and judgement.

In such diverse areas as office work, data processing, drafting, wholesale and retail trade, and computer programming, microcomputers are making it possible to utilize persons with lower skills to perform highly sophisticated functions.

Using computers does not necessarily require computer skills. For example, the new generation of office computers is specifically designed so that "no special computer skills are needed." The latest word processors can even correct typing errors automatically by the use of electronic dictionaries, so letter-perfect typing and strong spelling skills are no longer required.

As computer languages have become more "user-friendly" and sophisticated software has become available for a large variety of tasks, many computer programming positions have been eliminated or downgraded in terms of their skill requirements.

In fact, the use of sophisticated equipment often means that the worker requires less sophisticated skills. Today's Ford Escort is far more sophisticated than the Model T of 50 years ago. Yet it is far easier to drive today's vehicle. Computers are far more sopisticated today than they were 10 or 20 years ago. Yet the average programming task is considerably less demanding than it was when there was the need to reprogram plugboards and work in machine languages.

Workers will need to learn different skills rather than more demanding ones. Certainly word processing is different in some respects from typing. However the new skills needed can be acquired through on-the-job training. An expanded foundation in science, mathematics, and computer programming is hardly necessary.

We see an entirely different set of problems arising from high tech than is popularly assumed. Not only will the economy create more low-skill jobs than high, it is possible that high tech will eliminate far more jobs than it will create. For example, experts suggest that the use of computer-assisted design (CAD) software may eliminate a majority of the 300,000 drafters in the U.S.

If the future of work is being written in Silicon Valley, the danger signs are already evident. Although there are clearly some high-level executives, programmers, and engineers who are stimulated by their jobs in the Valley, most workers in these industries are clerical employes, assembly workers, and low-level technicians the challenges of whose labor may leave something to desired.

A recent front-page story in The San Jose Mercury estimated that a third of all workers in the Valley are involved in drugs and alcohol and that drugs are largely responsible for thefts on the job, accidents and a decrease in productivity and quality.

It is time that we take a clearer look at the job implications of high technology, rather than blindly accepting the folk wisdom on the subject.

Henry M. Levin is director of, and Russell Rumberger a research economist at, the Institute for Research on Educational Finance and Governance at Stanford University.

Mr. **Walgren**. I recognize at this point the co-chair of these hearings, Congressman Dick Gephardt of Missouri, for any opening comments he might like to make.

Mr. **Gephardt**. Thank you, Congressman Walgren. I deeply appreciate the help and cooperation that you have given in making these hearings possible and the work and help of your staff with the subcommittee. I think the idea of having two committees combine to address a topic that affects both is a rare opportunity and I think a necessary effort on the part of our committee structure with all the jurisdictional squabbles we often have in the Congress. I hope this is a precursor of more cooperative efforts between committees to try to address common problems.

I am extremely happy, therefore, to have the opportunity to help chair this important set of hearings. I think everyone agrees the topic is crucial to our future as a society. This is reflected in the nature of these hearings.

We are not investigating a narrow topic. The implications of what we are looking into will affect every committee in the Congress and every person in the United States.

From the perspective of the Budget Committee, answers to the questions we are posing are central to any discussion of government spending and deficits.

The impact of these issues on both tax revenues and Government outlays will be enormous.

The bottom line is that we need to know what is happening in our economy. This is a time of extremely rapid change in our society, greater than anything that has happened before. A number of interconnected forces are changing our lives. Some of these we can understand and predict. Others are far more mysterious and difficult to predict. Perhaps the most important of these are demographic changes, the internationalization of our economy and technology.

Demographics is a force we can understand fairly well. It doesn't change too rapidly. We can predict what is likely to result from current trends and changes.

We are only beginning to comprehend the effect of the internationalization of our economy on our lives. Most citizens of the United States have no idea that almost 30 percent of all goods produced in the United States are produced for export or that a similar percentage of all goods consumed in the United States are imported.

Technology is a wild card. We do not know what this will bring to us. The rate of technological change is increasing exponentially.

Over 90 percent of all knowledge produced by man has come in the last 100 years. This rate will continue to increase. All that we can predict with certainty is that the rapid growth of knowledge and new technology will transform our lives.

The United States is a highly dynamic society. We can change; indeed, we are already changing. That is good. We will probably be able to adjust better than any other society. We cannot control change nor can we control the pace of change.

I don't think we should attempt to. We must try to understand, to ease the transition, especially the social cost. People cannot be equated with capital. They are not another fluid factor of production. We cannot ignore this fact any more than we can ignore change itself.

We must find a way to live with change.

I hope our witnesses can provide us with the insight and information about this situation so that we can be better prepared for the policy decisions that await us in the Congress.

Again, I deeply appreciate the cooperation and help of Congressman Walgren and his staff and his subcommittee, and I look forward eagerly to the hearings that we are going to have in the seven sessions and believe that when they are finished we will have a better grasp of the problem and hopefully a better understanding of what we are called on to do in these committees and in the Congress.

Thank you.

Mr. **Walgren**. Let me recognize the other members that are here for any comments they might like to make.

Mr. Lundine, do you have any opening comments?

Mr. **Lundine**. Thank you, Mr. Chairman.

I just want to commend you and Congressman Gephardt for organizing these hearings and for compiling really interesting and important perspectives.

In your background material you asked whether the introduction of new technology creates more jobs in an expanding economy or contributes to unemployment and economic disarray.

I suspect the answer will be both. These seemingly impossible consequences are occurring, as my colleague from Missouri indicated, at an ever-accelerating rate.

I think these hearings are terribly important in that they follow up on other hearings which have been held in this and other committees, but that they take a wider perspective.

There is no topic more important in the United States today than assessing our overall economic competitiveness, productivity, and the impact of new technology on the work force.

I will look forward to learning and participating in these exciting hearings.

Mr. **Walgren**. Thank you, Mr. Lundine.

Mr. Skeen.

Mr. **Skeen**. Thank you, Mr. Chairman.

I too want to commend both of you for the joint hearing. The statements that both of you made today are significant in this respect. Nothing is new in what was said because the frustrating part of this whole area of inspection and investigation has been a point of awareness to all of us in the United States for a number of years.

The frustrating part is, we have been so powerless to do anything really significant insofar as government is concerned except go back to old programs, try old systems.

We have known about the educational gap; we have known about the advanced technology, but it seems that we don't do anything until crisis is upon us, so, when we reach a point of 10 percent unemployment, then we become very excited.

Because it is no longer just an issue that lies below the surface, it becomes very political.

I think that that is the frustrating part about this thing, that we don't react until something becomes political. I hope we go beyond the politics involved in the unemployment question.

It is time the United States stood up to the mirror, took a look at itself, and decided where do we go from this point and what is significant that we do insofar as transferring technology, the development of technology.

We are still the world's greatest technologists, without any question. How do we take advantage of our own advancements? Why do we have to give them away to other countries? Why is it that we cannot engender in our own young people the same kind of fervor that we have in foreign students who are going to our universities and will work day and night in the laboratory with our youngsters, it is difficult to get them to take even a lab course.

There are a lot of questions. I am sure the people we have today will bring some kind of answer. I hope that we are wise enough in this committee, in this joint committee, to be able to effect some kind of a change.

I do appreciate the work you folks have done, you two leaders, the chairman of both the subcommittees, because it is a question that we cannot let go by. We cannot ignore it.

Once again, I think it is time to stand up and look in the mirror. I hope the people we listen to during these 7 days will give us the kind of spur to make us move in some kind of direction that is helpful.

Thank you very much, Mr. Chairman.

Mr. **Walgren**. Thank you, Mr. Skeen.

Mr. Bateman.

Mr. **Bateman**. Thank you, Mr. Chairman. I too commend our leadership for having given the people a chance to come before us and hopefully to inform us as to how we can have some role in changing national policy and can do so in a way conducive to meeting an incredible challenge that lies ahead of us.

I think all of us here in the Congress are very much aware that we will either expand the frontiers of technology and the utilization of technology, or the American people will suffer a dramatic diminishment in the standard of living that we enjoy and that, indeed, 10 percent unemployment or possibly even worse will be a continuing phenomena, and I am sure all of us find that intolerable.

Certainly there is no prospect for maintaining the standard of living of the American people founded upon smokestack industries, production line work, or employment as we have heretofore known it.

We are either going to expand our technology and utilize that technology and train our work force to perform in that new atmosphere, or our standard of living is going to be dramatically adversely impacted.

Again, I commend our leadership for giving us this opportunity to focus on how we can avoid the negatives of what I have just expressed and hopefully to accentuate the positive.

Mr. **Walgren**. Mr. Boehlert.

Mr. **Boehlert**. Mr. Chairman, I want to thank you and your colleagues for having these hearings. They are very important. I would make this observation. Talk is cheap. It is action that counts.

I have been disturbed and was disturbed last week when I saw what happened when we considered important legislation on the floor. I think we are missing the boat.

We are doing so in spades when we fail to provide adequate funding for something near and dear to my heart, and that is instrumentation. When you consider the fact that our university research centers in the United States of America do not have access to the latest in computer technology, that not only is mind-boggling, it has to be very disturbing.

When you take a 42-year-old Nobel Prize winner like I have in my district, Dr. Kenneth Wilson, who is a national asset, even he does not have access to the latest in computer technology, and yet the average graduate student in Germany, Japan, the United Kingdom, France has that access, you begin to realize that we are missing the boat in a number of ways here.

Why does that relate directly to our hearings today? I think it is very simple. Most people, when they are students, particularly in their graduate years, are studying at our great learning centers like Cornell, Stanford, MIT—name them, across the board—they get their first exposure to the latest thinking and technology in a field like computers on the campus.

But yet our students in America today, our prospects for the future, the people that will help us build for a better day tomorrow, don't have that advantage because our university centers don't have the equipment; they don't have the technology.

So I would hope during the hearings today we would focus somewhat on that very real need.

I am glad to be here. I am glad to see we have a good representation. I think it is very important. I commend you both for conducting these hearings.

Mr. GREGG. I think we should get started, Mr. Chairman.

Mr. WALGREN. Somewhere I heard that before.

This morning we have two panels of prospective witnesess to address the relationship between technology and employment and help set the framework for much that is to follow.

I would like to ask two of the individuals on the first panel to come forward. They are Dr. Nathan Rosenberg, professor of economics from Stanford University, and Dr. Lawrence Klein, professor of economics from the University of Pennsylvania and recipient of the Nobel Prize.

We appreciate your coming. Any written statements or later submissions you would like to make we will be most happy to receive and will make part of the record.

Shall we start with Dr. Rosenberg? Make your points as best you can.

[The biographical sketch of Dr. Rosenberg follows:]

VITA

Nathan Rosenberg

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Born November 22, 1927, Passaic, New Jersey
Married, four children

Education

Rutgers University	1947-50	B.A., 1950 (Summa cum laude)
University of Wisconsin	1950-52	M.A., 1952
Oxford University	1952-54	
University of Wisconsin	1954-55	Ph.D., 1955

Honors and Awards

T.F. Vail Senior Class Prize (Rutgers) for Scholarship, 1950
Phi Beta Kappa
Scholarship, University of Wisconsin, 1950-51
Fellowship, University of Wisconsin, 1951-52
Fullbright Scholar, The Queen's College, Oxford University, 1952-54
Ford Foundation Faculty Research Fellowship in Economics, 1964-65
Fellow, American Academy of Arts and Science, 1981

Positions Held

Instructor, Indiana University, 1955-57
Assistant Professor, Department of Economics, University of Pennsylvania, 1957-61
Associate Professor, Department of Economics, Purdue University, 1961-64
Professor, Department of Economics, Purdue University, 1964-67
Visiting Professor, Department of Economics, Harvard University, 1967-69
Professor, Department of Economics, University of Wisconsin, 1969-74
Visiting Rockefeller Professor, Department of Economics, University of Philippines, 1970-71
Professor, Department of Economics, Stanford University, 1974-
Farleigh S. Dickinson, Jr. Professor of Public Policy, Stanford University, 1980-

Current Research

The economics of science and technology in the twentieth century.

Other Duties

Editor, Journal of Economic History, 1972-74.

Member, Department of Commerce, Technology Advisory Board, 1977-80.

Member, Organisation for Economic Cooperation and Development (Paris) Expert Group on Technology Transfer to Developing Countries.

Member, Organisation for Economic Cooperation and Development (Paris) Expert Group on Science and Technology in the New Economic Context.

Chairman, Social Science Research Council Subcommittee on Science Indicators.

Chairman, Stanford Program on Values, Technology and Society, 1976-78.

Director, Stanford Program on Public Policy, 1979-

STATEMENTS OF DR. NATHAN ROSENBERG, FARLEIGH S. DICKINSON, JR., PROFESSOR OF PUBLIC POLICY, STANFORD UNIVERSITY; AND DR. LAWRENCE R. KLEIN, BENJAMIN FRANKLIN PROFESSOR OF ECONOMICS (NOBEL LAUREATE), UNIVERSITY OF PENNSYLVANIA

Dr. ROSENBERG. Mr. Chairman, I am pleased to be here. I submitted to the committee a copy of a paper of mine that looks at recent trends in the world economy as they affect America's technological leadership, or more precisely, that discusses some of the reasons for the erosion of American technological leadership in several industries.

However, for purposes of this short oral presentation, I would like to make some brief observations on the longer term historical relationship between technological innovation and employment.

A major component of technological change is isolated when we recognize that its impact has been to raise productivity. That is, to increase the volume of output generated by a given amount of inputs. That, I would like to emphasize, is only part of the story. The impact of technological change has to be understood also in terms of the changing composition of output.

This, in turn, consists of two parts:

First of all, technological change has meant the availability of entirely new products.

Second, the rising levels of real income that are the other side of the coin, of the growing productivity made possible by technological innovation, have been associated with certain systematic changes in the pattern of consumer demand.

Each of these consequences of technological change has produced one common result. It has required shifting patterns in the use of labor. The benefits of technological change that are so visible on the output side have had as their counterpart the need to move labor from one activity to another, sometimes involving a shift of industry, sometimes a shift of occupation and skill level, sometimes a shift in geographic location.

The introduction of new products and the new patterns of consumer demand associated with higher levels of income have required a willingness to give up old activities and undertake new ones.

The need to do this has been powerfully reinforced by another aspect of technological change. I refer to its uneven incidence or impact. It is characteristic of the long-term impact of technological change that it is never an across-the-board phenomenon.

It has moved at different rates and different directions at different times. It raises productivity sharply in one industry or sector, but entirely neglects other sectors or raises productivity only much more slowly.

This unevenness in the productivity increasing effects of technological innovation has intensified the other forces at work requiring a continual reallocation of labor across industries and across occupational and skill boundaries.

Now, despite significant variations with respect to timing and rates of change, the historical process of the adoption of industrial technology has exercised certain broadly similar impacts upon the labor force of all countries that have gone through this process.

There has been, first of all, the increasing proportion of the labor force entering the industrial sector, a movement that has frequently been triggered by the adoption historically of factory technologies in textiles but with metallurgical sectors, metal using industries and new energy sources also playing a major initiating role.

The size of the labor force that eventually enters the manufacturing sector has varied considerably from one country to another.

In Great Britain, whose economy became very heavily committed to international trade and the importation of a large share of its food supply in the first half of the 19th century, the manufacturing sector grew rapidly.

But, even when Britain was acclaimed by the middle of the 19th century as the workshop of the world, the manufacturing sector, including her mining, never accounted for as much as one-half of the labor force.

In the United States the corresponding figures have been a good deal lower. While it is not generally realized, the manufacturing sector in the United States has never accounted for as much as 30 percent of the total labor force.

The long-term picture in all countries has been dominated by a declining agricultural sector, a sector that accounted for over 70 percent of the American labor force back in 1920, but accounts for less than 4 percent today.

That is a truly dramatic social transformation and this brings me by very simple subtraction to a basic point: A dominating feature of societies adopting industrial technologies, for reasons that are deeply ingrained in the nature of industrial production and the associated novel division of labor, has been the sustained growth in the service sector.

That includes not only personal services, but services in the broader sense of the wide range of activities that do not result in the direct production of commodities, wholesale and retail trade, finance, insurance, real estate, and government.

The fact of the matter is that if we classify the labor force by industrial sector, well over two-thirds of the American labor force is now engaged in the provision of services.

We are primarily today a service economy. It is not something down the road. It is already here.

This description, of course, involves painting with a very broad brush. If time permitted, which it doesn't, we could examine these long-term transformations in terms of the rise and decline of a large number of individual industries.

Let me, at least in the absence of doing that, make a few brief references to the British experience because some aspects of that experience may have relevance to our present concerns.

Britain's dominance of world trade in the middle decades of the 19th century, and to a declining extent thereafter, was rooted in the technologies which had formed the basis for the original industrial revolution.

Overwhelmingly this consisted of the output of the various sectors of the textile industry, especially cotton textiles, and to a much lesser degree, iron and steel manufacturing.

In 1830, textiles alone accounted for almost three-quarters of all British exports and the cotton sector, by itself, accounted for more than one-half.

Textiles, plus iron and steel manufacturers, which were far less important, in the same year, 1830, accounted for almost 85 percent of total British exports.

Now, whereas British exports were heavily based upon the industries which pioneered the industrial revolution, the British economy was much slower in exploiting the new industries which began to emerge late in the 19th century and early in the 20th century and which are sometimes referred to collectively as constituting the second industrial revolution.

To a much greater degree than was true of the older industries, these new industries were to involve the application and exploitation of some degree of scientific knowledge. This includes electricity and its multitudinous applications in engineering and machinery, organic chemistry, and its many ramifications, and the internal combustion engine.

Britain's early industrial leadership was not translated readily into those new production classes which have played an increasingly important role in the 20th century. This was true even in some cases such as the synthetic dye industry where the initial breakthroughs had occurred first in Great Britain.

It was only in the decades after the First World War that the British economy seriously confronted the structural transformations involved in making the transition to the new industries which had been pioneered elsewhere, especially by the Germans, Americans, and the French.

But Britain's deteriorating economic performance in the 20th century is not to be measured, as is rather naively done at times, by her declining relative importance in world trade and manufactured goods.

That decline was unavoidable, given the combination of rapid industrialization abroad and the obvious supply constraints upon a relatively small country. Rather, her deteriorating performance may be observed in her reluctance to exploit new technologies with anything like the success that she had demonstrated in the technology of textiles, coal, iron and steel of the original first industrial revolution.

In the 20th century the British economy responded slowly and sluggishly to the structural transformations required in the decline of old industries as well as the expansion of new ones. Industries such as textiles, coal, steel, shipbuilding, failed to achieve either sufficient reduction in size or technical modernization, where technical modernization was in fact possible.

The pressures to accomplish such structural transformations became increasingly urgent in the 20th century as wars, depression, and a growing recourse to policies of import substitution abroad brought about drastic changes in export markets for many of the traditional older industries.

Economic success for Britain and for industrial Europe more generally turned upon the ability to respond to changes in demand in world markets and to the opportunities presented by new technologies.

Britain, in spite of her early technological leadership, was unable to make the later structural transformations and it was this inability to transform that reduced her to essentially the status of a second rate industrial power in the course of the 20th century.

Let me now turn briefly to the prospects for the future. What is the impact of technological change likely to be in the years immediately ahead? There is a widespread apprehension that we are now poised at one of those great discontinuities in history and that new technologies are going to have unprecedentedly large effects in generating a permanent pool of unemployed.

This is feared because a number of new technologies—robotics, CAD/CAM, the growing capacity of the electronic chip, automation—are expected to have strong labor-saving effects.

It is, of course, impossible to prove anything about the future merely by looking at the past.

Some wise man once said it is difficult to make predictions, especially about the future. It is impossible to prove that we are not at some genuine discontinuity in history.

Furthermore, it is painfully clear the American economy is performing poorly and has been performing poorly for a decade or more. Productivity improvement has been particularly dismal and unemployment levels have been unacceptably high.

However, I do not believe that high unemployment has been primarily due to the character of technological change nor do I see any compelling reason to believe that new technologies will have an unusual job-reducing bias in the future. Some categories of employment will, of course, suffer.

Technological change always has reduced specific categories of employment, whether it is farm workers, coal miners, railroad workers, lumberjacks, whatever.

The electric light displaced the candlemaker and the automobile put saddlers and whipmakers out of business. The crucial question, it seems to me, is whether the thrust of technological change is to reduce total employment, not whether it eliminates specific jobs.

Of course it does the latter. I think two points are worth making in that context.

First of all, labor-saving innovations are not the same as job-reducing innovations.

The reductions in cost and price associated with labor-saving innovations may bring in their wake vast increases in specific kinds of employment.

After all, when Henry Ford introduced the progressive assembly line into the American automobile industry in 1914, the result was a huge reduction in the number of labor hours required to produce a car; but the resulting ability to sell a Model T Ford for only $400 was a revolutionary event economically speaking, an event that resulted in an enormous increase in employment in the automobile and related industries.

I might add parenthetically that in the present international context new steps forward in automation may increase U.S. employment by repatriating activities that have recently moved overseas. Thus the automation of a variety of labor-intensive assembly line work may well bring jobs back to the United States that have recently migrated overseas, specifically in the search for cheaper labor.

Second, as a general matter it seems to be much easier to anticipate the employment displacing effects of technological change than the employment expanding ones.

I think there is a systematic foreshortening of our ability to think about this future impact. The anticipation of employment expanding consequences of innovations seems to require a much greater exercise of the social imagination, an ability to foresee uses in entirely new social contexts.

It is instructive to go back and look at what people were saying in the early history of the radio where it was predicted the radio would be used to communicate with ships at sea and to communicate with certain remote mountain locations.

That is to say, it would be used to communicate where wires were not possible. Of course, in many parts of the world, like Great Britain, it is still called the wireless. Nobody anticipated the impact of the radio as a device for entertainment, recreation, transmission of news, education, and so on. That is simply historical fact.

Going back not so far in history, you can find in the 1950's a number of very authoritative people, in speaking about the impact of the computer, saying that the future computer requirements of the United States will be satisfied by 10 or 12 large computers.

That statement seems extraordinary in retrospect, yet I think it is important to see that is the way people thought about it at the time. Thomas Edison is reputed by one of his biographers to have said the phonograph was going to be used primarily to record the death wishes of elderly gentlemen. It is extremely difficult to anticipate the impact of new innovations because this impact is never something which is inherent in a piece of hardware.

It depends rather on social uses and cultural contexts, on how society chooses to mobilize the technological potential of a piece of hardware.

So that I believe there is a systematic bias in our perceptions about the future. This bias sharpens our awareness of possible job-reducing consequences of technological change, but at the same time fails to identify the prospects for enlarged employment opportunities that flow from the ability to produce certain products more cheaply or to invent entirely new products with quite unanticipated uses and applications.

In this context, I think it is appropriate to remind you that a national Commission on Technology, Automation and Economic Progress, was established by Congress in 1964 animated by a similar set of concerns over the prospects of rising levels of technological unemployment.

In addition to its excellent final report called "Technology and the American Economy," that Commission produced six volumes of material on the subject that still make valuable reading today.

Interest in the subject of technological unemployment subsequently faded in the late 1960's along with the decline in unemployment levels.

I think it is also essential to keep even our dissatisfactions in perspective here. Although the decade of the 1970's was, economically speaking, a dreary one, there were also some very positive achievements. The fact of the matter is that civilian employment increased by more than 20 million jobs between 1970 and 1980.

That, I submit, is a very remarkable development. It was a very considerable achievement and this success in rapidly absorbing new recruits into the labor force was also, of course, closely connected with the poor productivity performance of that decade.

Indeed, in some respects this was obviously the other side of the coin of the slow productivity growth. In saying this, in reminding you of the earlier automation studies, I am anxious not to appear complacent by assuring you that your present concerns are merely a replay of old familiar themes.

Far from it. I believe that the present state of our economy and its prospects for the future offer a great deal to worry about, but I also believe that it is very important that we worry about the right things.

What concerns me very much is that we should make a correct diagnosis of the source of our present economic difficulties. We don't need, I think, to belabor the point which has already been made, that 10 percent unemployment is socially as well as economically disgraceful, even though it may not be as painful as similar rates would have been 30 or 50 years ago.

I expect technological innovation to continue to require labor force shifts and reallocations as it has in the past. These shifts are extremely painful to the individuals and families concerned and the magnitude of these shifts has been enlarged by drastic changes in America's position in world markets in the last 10 or 15 years.

Such changes are, in an important sense, part of the social cost of technical progress, and I would certainly look with favor upon policies that offer the prospect of genuinely speeding these transmissions and reducing the painfulness of the adjustment process.

What I want to insist upon, in closing, is that I see no evidence to support the expectation that technological innovation is now poised to inflict unemployment of a vastly enlarged scale as compared with our historical experience.

I believe such fears are based upon a misdiagnosis and that our present difficulties lie primarily in the macroeconomic sphere.

If that misdiagnosis led to measures that slowed down our capacity to exploit a new generation of technologies or to prolong artificially the economy's attachment to obsolescent technologies or to protectionism, it would seriously damage America's viability in an increasingly competitive world economy.

America's comparative advantage, I believe, continues to lie in the direction of the generation and the exploitation of new technologies.

Thank you.

[The prepared statement, plus additional material submitted by Dr. Rosenberg, follow:]

Nathan Rosenberg
Stanford University

I have submitted to the Committee a copy of a paper of mine that looks at recent trends in the world economy as they affect America's technological leadership - or, more precisely, that discusses some of the reasons for the erosion of American technological leadership in several industries. However, for purposes of this short oral presentation, I would like to make some brief observations on the longer-term historical relationship between technological innovation and employment.

A major component of technological change is isolated when we recognize that its impact has been to raise productivity, i.e., to increase the volume of output generated by a given amount of inputs. But that, I would like to emphasize, is only part of the story. The impact of technological change has to be understood also in terms of the changing composition of output. This in turn consists of two parts. First of all, technological change has meant the availability of entirely new products. Secondly, the rising levels of real income (that are the other side of the coin of the growing productivity made possible by technological innovation) have been associated with certain systematic changes in the pattern of consumer demand.

Each of these consequences of technological change has produced one common result: It has required shifting patterns in the use of labor. The benefits of technological change that are so visible on the output side have had as their counterpart the need to move labor from one activity to another, sometimes involving a shift of industry, sometimes a shift of occupation and skill level, sometimes a shift in geographic location. The introduction of new products and the new patterns of consumer demand associated with higher levels of income have required a willingness to give up old activities and to undertake new ones.

The need to do this has been powerfully reinforced by another aspect of technological change: its uneven incidence. It is characteristic of the long-term impact of technological change that it is never an across-the-board phenomenon. It has moved at different rates and in different directions at different times. It raises productivity sharply in one industry or sector, but entirely neglects other sectors or raises productivity only much more slowly. This unevenness in the productivity-increasing effects of technological innovation has intensified the other forces at work requiring a continual reallocation of labor across industries and occupational and skill boundaries.

In spite of significant variations with respect to timing and rates of change, the historical process of the adoption of industrial technology has exercised certain broadly similar impacts upon the labor force of all countries that have gone through this process. There has been, first of all, the increasing proportion of the labor force entering the industrial sector, a movement that has frequently been triggered by the adoption of factory technologies in textiles, but with the metallurgical sectors and metal-using industries and new energy sources also playing a major initiating role. The size of the labor force that eventually enters the manufacturing sector has varied considerably from country to country. In Great Britain, whose economy became very heavily committed to international trade and the importation of a large share of its food supply in the first half of the 19th century, the manufacturing sector grew rapidly. But, even when Britain was acclaimed as "the workshop of the world", the manufacturing sector (including mining) never accounted for as much as one half of the labor force. In the U.S. the corresponding figures have been a good bit lower. Although it is not generally realized, the manufacturing sector in the U.S. has never accounted for as much as 30% of the total labor force.

The long-term picture in all countries has been dominated by a declining agricultural sector, a sector that accounted for over 70% of the American labor force back in 1820, but accounts for less than 4% today. And this brings me, by simple subtraction, to a basic point: A dominating feature of societies adopting industrial technologies, for reasons that are deeply ingrained in the nature of industrial production and the associated division of labor, has been the sustained growth of the service sector (sectors) - including here not only personal services but services in the broader sense of the wide range of activities that do not result in the direct production of commodities: wholesale and retail trade, finance, insurance, real estate, and government. The fact of the matter is that if we classify the labor force by industrial sector, well over two-thirds of the American labor force is now engaged in the provision of services.

This description, of course, involves painting with a very broad brush. If time permitted, which it does not, we could examine these longterm transformations in terms of the rise and decline of a large number of individual industries. Let me at least make a few brief references to the British experience, because some aspects of that experience may be of relevance to our present concerns.

Britain's dominance of world trade in the middle decades of the 19th century and to a declining extent thereafter was rooted in the technologies which had formed the basis for the original industrial revolution. Overwhelmingly this consisted of the output of the various sectors of the textile industry - especially cotton textiles - and, to a much lesser degree, iron and steel manufactures. In 1830 textiles alone accounted for almost three-quarters of all British exports, and the cotton sector by itself accounted for more than one half. Textiles plus iron and steel manufactures (which were far less important) in the same year accounted for almost 85% of total exports.

Whereas British exports were heavily based upon the industries which had pioneered the industrial revolution, the British economy was much slower in exploiting the new industries which began to emerge late in the 19th century and early in the 20th century, and which are sometimes referred to collectively as constituting the "Second Industrial Revolution." To a much greater degree than was true of the older industries, these new industries were to involve the application and exploitation of some degree of scientific knowledge. This includes electricity and its multitudinous applications in engineering and machinery, organic chemistry and its many ramifications, and the internal combustion engine. Britain's early industrial leadership was not translated readily into those new product classes which have played an increasingly important role in the twentieth century. This was true even in some cases, such as the synthetic dye industry, where the initial breakthroughs had occurred first in Britain. It was only in the decades after the First World War that the British economy seriously confronted the structural transformations involved in making the transition to the new industries which had been pioneered elsewhere - especially by the Germans, Americans and French.

But Britain's deteriorating economic performance in the 20th century is not to be measured, as is rather naively done at times, by her declining relative importance in world trade in manufactured goods. That decline was unavoidable, given the combination of rapid industrialization abroad and the obvious supply constraints upon a relatively small country. Rather, her deteriorating performance may be observed in her reluctance to exploit new technologies with anything like the success she had demonstrated with the technology of textiles, coal, iron and steam of the original industrial revolution. In the 20th century, the British economy responded slowly and sluggishly to the structural transformations required in the decline of old industries as well as the expansion of new ones. Industries such as textiles, coal, steel and shipbuilding failed to achieve either sufficient reduction in size or technical modernization, where the latter was possible. The pressures to accomplish such structural transformations became increasingly urgent in the 20th century as wars, depression and a growing recourse to policies of import substitution abroad brought about drastic changes in export markets for many of the traditional, older industries. Economic success for Britain, and for industrial Europe more generally, turned upon the ability to respond to changes in demand in world markets and to the opportunities presented by new technologies. Britain, in spite of her early technological leadership, was unable to make the later structural transformations. It was this inability to transform that reduced her to the status of a second-rate industrial power in the course of the 20th century.

Let me now turn briefly to the prospects for the future. What is the impact of technological change likely to be in the years immediately ahead? There is a widespread apprehension that we are now poised at one of those great discontinuities in history, and that new technologies are going to have unprecedentedly large effects in generating a permanent pool of unemployed. This is because a number of new technologies - robotics, CAD/CAM, the growing capacity of the electronic chip, automation - are expected to have strong labor-saving effects.

It is, of course, always impossible to prove anything about the future merely by looking at the past. It is impossible to prove that we are not at some genuine discontinuity in history. Furthermore, it is painfully clear that the American economy is performing poorly and has been performing poorly for a decade or more. Productivity improvement has been particularly dismal, and unemployment levels have been unacceptably high.

However, I do not believe that high unemployment has been primarily due to the character of technological change, nor do I see any compelling reason to believe that new technologies will have an unusual job-reducing bias in the future. Some categories of employment will, of course, suffer. Technological change has always reduced specific categories of employment - e.g., farm workers, railroad workers, coal miners, lumberjacks. The electric light displaced the candle maker, and the automobile put saddlers and whip makers out of business. The crucial question is whether the thrust of technological change is to reduce total employment, not whether it eliminates specific jobs. Two points are worth making.

1. Labor-saving innovations are not the same as job-reducing innovations. The reductions in cost and price associated with labor-saving innovations may bring in their wake vast increases in specific kinds of employment. When Henry Ford introduced the progressive assembly line into the American Automobile industry in 1914, the

result was a huge reduction in the number of labor hours required to produce a car. But the resulting ability to sell a Model T Ford for only $400 was a revolutionary event that resulted in an immense increase in employment in the automobile industry (I might add parenthetically that, in the present international context, new steps forward in automation may increase U.S. employment by repatriating activities that have recently moved offshore. Thus, the automation of a variety of labor-intensive assembly line work may well bring jobs back to the U.S. that have recently migrated overseas in search of cheaper labor).

2. As a general matter, it seems to be much easier to anticipate the employment-displacing effects of technological change than the employment-expanding ones. The anticipation of the employment-expanding consequences of innovations seems to require a much greater exercise of the social imagination, an ability to foresee uses in entirely new social contexts. Even a causal glance back into history appears to confirm this. In the early days of the radio, it was anticipated that it would be used primarily as a device for communicating with places where wire communication was impossible, such as remote mountain locations and ships at sea - hence the term "wireless". No one seems to have correctly anticipated the immense commercial, entertainment and educational uses to which the invention was put during the twentieth century. In the 1950s, when the computer was still in its infancy, it was confidently predicted that all of America's future needs would be adequately catered to by a dozen or

so computers. Even Thomas Edison, a genuine inventive genius, is said by one of his biographers to have anticipated that the phonograph would be used primarily to record the death-bed wishes of elderly gentlemen! The point is that it is extremely difficult to anticipate the impact of new innovations, because that impact is not something inherent in the hardware. It depends, rather, on social uses and cultural contexts, on how society chooses to mobilize and to exploit the potential of a piece of hardware.

Thus, I believe that there is a systematic bias in our perceptions about the future. This bias sharpens our awareness of possible job-reducing consequences of technological change but at the same time fails to identify the prospects for enlarged employment opportunities that flow from the ability to produce certain products more cheaply or to invent entirely new products with quite unanticipated uses and applications.

In this context I think it is appropriate to remind you that a National Commission on Technology, Automation and Economic Progress was established by Congress in 1964, animated by a similar set of concerns over the prospects of rising levels of technological unemployment. In addition to its excellent final report, Technology and the American Economy, that commission produced 6 volumes of material on the subject that still make valuable reading today. Interest in the subject of technological unemployment faded in the late 1960s along with the decline in unemployment levels.

I think it is also essential to keep even our dissatisfactions in proper perspective. Although the decade of the 1970s was, economically speaking, a dreary one, there were also some very positive achievements. The fact of the matter is that civilian employment increased by more than 20 million jobs between 1970 and 1980. That was a very considerable achievement - and this success in rapidly absorbing new recruits into the labor force was also closely connected with the poor productivity performance of that decade. It was, in some respects, the other side of the coin.

In reminding you of earlier automation studies, I am anxious not to appear complacent by assuring you that your present concerns are merely a replay of an old familiar theme. Far from it. I believe that the present state of our economy and its prospects for the future offer a great deal to worry about, but I also believe that it is important that we worry about the right things. What concerns me very much is that we should make a correct diagnosis of the sources of our present economic difficulties. We don't need to belabor the point that 10 percent unemployment is socially as well as economically disgraceful, even though it may not be as painful as similar rates 30 or 50 years ago.

I expect technological innovation to continue to require labor force shifts and reallocations as it has in the past. These shifts are extremely painful to the individuals and families concerned, and the magnitude of these shifts has been enlarged by drastic changes in America'a position in world markets in the last ten or fifteen years.

What I want to insist upon is that I see no evidence to support the expectation that technological innovation is now poised to inflict unemployment of a vastly enlarged scale as compared with our historical experience. I believe such fears are based upon a misdiagnosis, and that our present difficulties lie primarily in the macroeconomic sphere rather than in the sphere of technologically-generated unemployment. If that misdiagnosis led to measures that slowed down our capacity to exploit a new generation of technologies, or to prolong artifically the economy's attachment to obsolescent technologies, or to protectionism, it would seriously damage America'a viability in an increasingly competitive world economy. America's comparative advantage, I believe, continues to lie in the direction of the generation and exploitation of new technologies.

Inside the black box

Technology and economics

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12 U.S. technological leadership and foreign competition: *De te fabula narratur?*

I begin with a brief deck-clearing operation, one that I hope will be noncontroversial. The discussion of America's role in international markets for high-technology products was for a long time dominated by some highly unrealistic expectations. These expectations were formed in the years immediately following World War II, when a whole generation of Americans grew up surrounded by tangible evidence of America's across-the-board technological superiority. For twenty years or so following the Second World War, and for reasons closely connected with the uneven incidence of that war and its sequelae, American technological leadership was one of the prime facts of international life. The years from 1945 to the mid- or late 1960s were, without doubt, the age of American technological hegemony.

Precisely because of their comparative technological backwardness, however, the other Organization for Economic Cooperation and Development (OECD) member countries were able to combine their recovery, not only from wartime destruction but from a longer period of neglect stretching back to World War I, with a rapid rate of technical improvement. So long as there remained a substantial gap between technology levels in the United States and the other advanced industrial countries, there was a possibility of rapid technological change through the transfer and adoption of the more sophisticated and productive American technology.

Thus, throughout the 1950s and 1960s, and with varying degrees of effectiveness, the other OECD countries played a highly successful game of technological catchup. A combination of high rates of capital formation – on the average far higher than in the United States – plus the importation and exploitation of more advanced American technologies,

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brought a progressive narrowing of American technological leadership vis-à-vis Europe and Japan.

These developments also resulted in far higher rates of productivity growth abroad by comparison with the United States. These trends came to be regarded as alarming in America only in the 1970s, when our own rate of productivity growth, which had long trailed behind those abroad, fell precipitously after a perceptible but slower decline in the late 1960s.

At present, therefore, in many fields, America's earlier lonely eminence at numerous technological frontiers has passed. Today, other industrial nations have attained positions close to, or at, these same frontiers. In many ways, this situation should be cause for rejoicing: We are no longer living in the readily identifiable aftermath of the most destructive war in history. Although we are, perhaps understandably, preoccupied with the more competitive aspects of the situation, we need to be reminded that companionship at the technological frontier offers considerable benefits as well as costs. This brings me to one of my central themes: In the years immediately ahead, I expect to see a good deal of convergence in the economic environment of a sizeable number of countries. By contrast with the postwar years of American hegemony, we are likely to see several technological competitors functioning within increasingly similar economic environments and therefore responding to increasingly similar stimuli and problems.

It is very plausible to argue that the extent of U.S. technological leadership and higher income levels in the early postwar decades were so great that they limited our capacity to derive much benefit from the technological activities of other countries – at least in terms of the possibility of transferring useful technology, as opposed to the benefits that occurred through normal trade relations. From this point of view, the growing similarity of certain conditions in other industrial countries is increasing our capacity to derive such benefits. More rapidly rising labor costs in Japan and Western Europe and the increasing relative scarcity of certain raw materials in the United States contribute to this greater likelihood. Foreigners are increasingly responsive to innovative possibilities that will benefit us, such as labor-saving innovations. Moreover, resource-saving innovations, which have long been of greater concern to other countries, are becoming more relevant and applicable in the United States. This point is being forcefully underlined by the huge influx of more energy-efficient Japanese cars. More generally, as real incomes abroad rise more rapidly than in the United States, one may readily expect a greater number of attractive new products, designed mainly for affluent households, to enter the U.S. market from abroad.

As a result of these trends, it is already becoming difficult to determine whether some developments reflect further erosion of American technological leadership as opposed to other commercial considerations. Consider the recent rise in foreign patenting in the United States, which has often been cited as evidence of increasing inventive capability in other countries relative to the United States. It is doubtful that such data constitute good evidence of the changing relative pace of technological progress. It is more plausible to argue that the rising percentage of patents in the United States obtained by foreigners has been dominated by commercial judgments and considerations such as changes in the size of specific markets, in the composition of demand, in relative prices, and so on. They do not necessarily indicate changing technological capabilities. Some of these changes may reflect the impact of growing concern over environmental pollution and other hazards that have become embodied in government regulations. The rising sensitivity to pollution has considerably increased the proprietary value of high-performance automobile emission-control devices and has led to decisions to enter the American market with technologies that, in some cases, had been around for some time. The rise of energy prices may be drastically increasing the profitability of energy-conserving technologies in the American market. Because American energy prices have long been below those of the rest of the world, it is reasonable to believe that their dramatic rise in the 1970s increased considerably the profitability in the U.S. market of energy-saving devices or designs that were *already* in use in other countries. Such price changes would have the effect of making patents in the U.S. market more commercially attractive than they were previously. No change in relative inventiveness has necessarily taken place. Thus, increased patenting by foreigners in the U.S. market may indicate little about changes in inventiveness between the United States and the rest of the world and a great deal about the changing pattern of incentives generated by underlying economic forces. In *some* respects, of course, the final outcome may be the same, whether the intensifying competitive challenge to an American high-technology firm is the result of shifts in international technological capabilities or increasing similarity in the economic conditions of a growing number of industrial countries. From a policy point of view, however, correct diagnosis may make a great deal of difference.

The perspective I have laid out has an additional implication that deserves to be made explicit. The changed American international position is readily subject to a variety of alarmist interpretations. Indeed, there are aspects of our recent economic performance that I find particularly alarming—such as the extremely poor productivity growth of the American economy during the 1970s. Nevertheless, policy formulation is not well served by mindless extrapolations from the recent past. To the extent that I am correct in my analysis of technological catchup abroad and the growing similarity of conditions between the United States and those countries that have been successful in catching up, it would be unwarranted to expect the economic performance of those countries rapidly to surpass that of the United States. On the one hand, rapid technological change becomes much more difficult to sustain as the technological frontier is approached and reached. Catchup gives way to the more difficult and costly joint participation in the process of pushing out that frontier. Additionally, economies that arrive at affluence may be expected to share some of the features that slowed down the growth of the technological leader – including an increasing commitment to improving the quality of the environment, a growing sensitivity to safety and health and other "amenity" considerations, the eventual exhaustion of the labor pool from low-productivity agricultural occupations that could, by moving elsewhere, make substantial contributions to productivity growth, the growing size of the service sector, where productivity improvements seem more difficult to attain than in the commodity-producing sector, and so on. Thus, an alternative to the scenario of other industrial countries rapidly surpassing America in technological and economic leadership is that of a number of countries drifting, within a narrowing range, toward some asymptotic level of economic performance, a level first attained by America. As the gap between them narrows, the later arrivals come increasingly to assume some of the characteristics of the leader. As Marx, writing of the industrial revolution in England, warned his European readers in the preface to *Capital:* "The country that is more developed industrially only shows, to the less developed, the image of its own future." Or, as he warned them more succinctly in the previous paragraph: "De te fabula narratur!"[1]

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[1] Karl Marx, *Capital* (The Modern Library, New York, n.d.), p. 13. Of course, England's disappointing economic performance in the century or so since the publication of *Capital* in 1867 does represent a conceivable scenario for the United States. In that case, the United States would be overtaken and surpassed by more vigorously growing economies, just as England was eventually surpassed by the United States, Germany, and Japan. The intriguing question here is whether there is a peculiarly English disease accounting for its lackluster performance or whether its experience is the reflection of more deeply rooted forces that will inevitably assault all countries at some sufficiently advanced stage of industrial maturity.

II

A central feature of high-technology industries that is likely to become increasingly significant is an apparently inexorable rise in the development costs of new products. In some measure, these rising costs are inevitable when complex, state-of-the-art products are being designed and when performance improvements are likely to bring great advantages. The move toward higher performance levels commonly involves higher development costs, because there is an identifiable tradeoff where better performance is available at higher cost (as, for example, in the decision to use more expensive materials). Additionally, however, the competitive process also drives firms to bring the new product into the market ahead of the competition. Greater speed in new product development—in the extreme case, the "crash program" approach—is inherently more costly than a slower, step-by-step, sequential process. This approach is most readily observable in advanced weapons development for the military and the space program, where costs are less important than performance improvement and where cost overruns are tolerated as an unavoidable fact of life. Although the beneficial spillovers from the military and space programs to the civilian sector are often cited, far less attention has been given to their possible deleterious effects in raising the costs of civilian R&D and in reducing the sensitivity of American engineers to cost considerations of a kind that are likely to be decisive in commercial markets.

The extreme impact of rising development costs is particularly apparent in the commercial aircraft industry, especially since the advent of the jet engine in the 1950s. For some years, commercial aircraft manufacturers were able to limit development costs by adopting new technologies only after they had been produced and operated for some years by the military. The Boeing 707 was a civilian version of the KC-135 military tanker, an aircraft that had been produced in large numbers for the military, and even the 747 benefited from the development experience Boeing derived from its unsuccessful bid in the C-5A competition. With the increased focus upon missiles, however, the military and commercial sectors have diverged. Commercial firms now confront costs of the order of magnitude of $1 billion in developing a new generation of widebodied jets and have less direct financial support from earlier military technologies. In 1981, McDonald-Douglas refused an offer by Delta Airlines to undertake the development of a new commercial aircraft, despite Delta's willingness to place an order of over $1.5 billion.

Thus, in the commercial aircraft industry, participating firms confront extremely high development costs in addition to the costs of production. This problem is compounded by the fact that the market for commercial aircraft is relatively small—in part, a testimony to the high productivity of commercial jets. Few commercial jets ever sell in excess of a few hundred units—and only two (the 727 and the DC-9) have ever sold in excess of 1,000.

Thus, the extreme commercial risks posed by high development costs are likely to dominate developments in this industry in the future. Subcontracting, at least partially as a risk-sharing device, is already an important aspect of the industry. Boeing had six major subcontractors for the 747, with whom it shared the development costs and risk, and the development of the aircraft began only after firm purchase commitments were in hand from Pan Am, TWA, Lufthansa, and BOAC. Boeing has subcontracting arrangements for its new-generation 767 and 757 with a number of foreign firms—Japanese, Canadian, Italian, British. One cannot help wondering to what extent such international subcontracting is also motivated by the perception that the arrangement will make it easier to enter those commercial markets.

High development costs and large financial risks also figure prominently in the increasingly European recourse to international consortia—as in the case of the successful Airbus and the ill-fated Concorde. Although there are presently only three commercial airframe manufacturers and two commercial jet engine manufacturers in the United States, the numbers are even smaller in Western Europe, where the industry is now largely nationalized.[2] In addition, it is important to observe that the Concorde, a brilliant engineering achievement but a commercial disaster (only sixteen were manufactured before production was discontinued), was made possible by immense subsidies from the French and British governments.

The huge development costs and the associated financial risk of commercial aircraft are paralleled by similar trends in other high-technology industries. There are obvious parallels in the field of military procurement—with the additional special problem of a single buyer. Development costs of nuclear power reactors, where safety and environmental considerations are especially important, have inexorably risen. More conventional power-generating equipment, although not plagued by the special problems of nuclear power, involves technological and other performance uncertainties that have resulted in very high development costs. The exploitation of new fossil-fuel energy sources, involving liquefaction and gasification, is almost certain to encounter spectacular development costs, as is already clear at the pilot-plant stage. Telecommunications, involving extreme systemic complexity, compatibility, and interdependence problems, and the special features associated with network evolution, also encounters very high development costs; the cost of the no. 4 Electronic Switching System was about $400 million. Finally, although the electronics industry has some very different features from the industries just mentioned, the design and development of reliable, high-capacity memory chips has drastically raised the stakes for commercial survival. Almost daily reports in the financial press suggest that hundreds of millions of dollars in development costs are being incurred in the international competition for the 64K RAM market. The prospects for recovering these development costs have been jeopardized by widespread price cutting.

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[2] Shortly after this was written (November 1981), Lockheed announced its intention to terminate the production of the wide-bodied L-1011. When that happens, there will be only two American commercial airframe manufacturers.

Thus, industries confronting a combination of dynamic, rapidly improving technology and high development costs may be expected to share many problems in varying degrees. Financial risks are becoming exceedingly great, in some cases requiring markets substantially larger than can be provided by a single moderately sized Western European country. For technological and other reasons (sometimes regulatory), long lead times are often involved; thus, the full recovery of an investment is deferred, at best, to the far distant future. Not only are technological uncertainties extreme, but the large financial commitments are frequently required during precisely that early stage when uncertainties are greatest. The very fact of rapid technological change raises the risk of investing in long-lived plant and equipment because further technological change is likely to render such capital soon obsolete. If, as is widely asserted, product life cycles are themselves becoming shorter, the agony of the risk-taking process is further intensified. What is certainly true is that in committing large amounts of resources to the development process, timing becomes even more crucial. There is abundant recent evidence that new, technologically complex products experience numerous difficulties in their early stages that may take years to iron out. The earliest Schumpeterian innovators frequently wind up in the bankruptcy courts. The strategy of a rapid imitator, or "fast second," benefiting from the mistakes of the pioneer has much to commend it, especially when rapid technological change is expected to continue. This was clearly the case with British pioneering of the commercial Comet I, well before American entry into the commercial jet age. As it happened, substantial improvements in engine performance in the next couple of years offered Boeing and Douglas decisive commercial advantages, in terms of greater capacity and speed, that were incorporated into their later entrants – the 707 and DC-8.

The development process eventually dovetails into investment in plant and equipment. Indeed, in a high-technology world of prototypes and pilot plants, it may be impossible to draw a sharp line of demarcation between the two. In other respects, however, high-technology industries are bringing the two stages even closer together. Increasingly in some of these industries, the performance of the final product and the efficiency of the productive process are extremely sensitive to the precise nature of the process technology involved in manufacturing. In electronics, yield and performance are closely linked to the maintenance of scrupulously high standards of cleanliness and other related aspects of quality control. Thus, innovation in electronics has created even greater intimacy between product and process innovation, which must now be considered together. The great increase in circuit-element density, leading to dramatic improvements in the capabilities of an integrated circuit chip, has been inseparable from the introduction of more complex processing equipment. This processing equipment, in turn, raised the fixed costs of a wafer fabrication plant from $2 million to $50 million during the 1970s. Such high-capacity plants, of course, need to operate at very large volumes.

Here again, high-technology innovation intensifies the need for expanding output and pushes producers beyond the limitations imposed by domestic markets. For a variety of reasons, including tariffs and other forms of protective legislation that place imported products at a competitive disadvantage, multinational firms may attempt to exploit foreign markets by establishing a local subsidiary. Such actions obviously accelerate the transfer of technology; indeed, multinational firms are now a main instrument for the more rapid international diffusion of advanced technologies.

In an increasingly interdependent world, it becomes more and more difficult to isolate the domestic and international contexts of decisions regarding innovation. Thus, it is not sufficient to argue that transferring a technology overseas has the unambiguous effect of narrowing the technology gap between the United States and the rest of the world. Obviously, in making a decision to develop a new technology in the first place, a high-technology firm will take into account the prospect of earning revenues from overseas as well as in domestic markets. How important these prospects are is a difficult matter of commercial judgment, but it seems apparent that American firms are more willing to undertake development expenditures at home if there is a possibility of eventually transferring the technology overseas. This factor, if at work, will strengthen the willingness to commit resources to the innovation process. In a world of shortening product life cycles and the more rapid diffusion of new technologies, the willingness to undertake domestic innovative activity may be strengthened by the prospect of overseas payoffs. And a speeding up of the international diffusion of new technologies seems to assure a shortening of the time period for an innovating firm to exploit its technological lead.

In an increasingly interdependent world with rapidly advancing technologies, we must also question the propriety of treating an "industry" as some ultimate or indivisible unit of analysis. Consider, for example, the dissolution of the boundary line that could once be drawn between the telecommunications and computer industries. The microchip revolution and the growing information-processing needs of business are converting computers into forms that increasingly resemble telecommunications networks, whereas the old telephone system has already become, in a very meaningful sense, a gigantic computer. But, more generally, reduced transportation costs, or the increasing prominence of industries in which such costs are relatively insignificant, such as electronics, make possible new divisions of labor. Such arrangements make it feasible for an industry to parcel out separate activities or components on a truly international basis. Thus, buyers of Boeing's forthcoming 767 will purchase an airframe the components of which have been manufactured in several countries on different continents; Boeing will happily deliver the aircraft equipped with either American (Pratt and Whitney or General Electric) or British (Rolls Royce) engines to suit the preference of the buyer. The European Airbus, on the other hand, comes equipped with American engines (General Electric).

The computer industry, at present, is still characterized by American dominance of world markets (about 80 percent of the total). However, with the growing Japanese domination of memory chips, there is apprehension of an eventual Japanese monopoly of that particular strategic component. A situation in which the United States dominates the brains of the computer, the logic circuits, and the Japanese the memory circuits, is perfectly feasible. Alternatively, although there is an increasing resort to Japanese components, American manufacturers continue to dominate the mainframe market. Finally, although Japanese performance in hardware continues to improve, American superiority in software appears to remain overwhelming. The Japanese failure to approach American sophistication in software accounts, in turn, for their inability to make larger inroads into the rapidly expanding minicomputer and personal computer markets, where software is especially crucial.

The purpose of these references is emphatically *not* to suggest that the present lines of demarcation between American and Japanese strengths will remain unaltered. That would be foolhardy. Rather, it is to suggest the possibility of entirely new patterns of specialization at the common technological frontier, as more and more nations reach that frontier. These new patterns may be such that it makes little sense to apply terms such as *technological leadership* or *technological gaps* to entire industries, much less entire countries. There may be persistent reasons for a country to retain technical and commercial superiority in specific segments of an industry while not dominating the entire industry. Moreover, it is entirely possible that countries that are generally regarded as far from the technological frontiers and at intermediate stages of industrialization—India, Brazil, Mexico—may establish niches for themselves in certain portions of high-technology industries.

In addition, we should recognize the limits of the explanatory power of the technological variable by itself. Success in high-technology markets is not reducible to mere technological capability. Such success is also a matter of organizational flexibility, managerial effectiveness, the social and economic rewards of risk taking, the efficiency of capital markets, and a number of other environmental factors that may affect the ability to convert technological opportunities into commercially successful innovations, whether these opportunities first emerge at home or abroad.

III

Finally, certain questions must be addressed concerning the interface between science and technology—and it is perhaps the intensity of activity at that interface that defines a high-technology industry in the first place. The long-term vitality of such industries is directly dependent upon the degree of success in achieving creative interactions between the two realms. Yet, we are far from having a really good understanding of the conditions that make for successful interactions, and how they can be encouraged.

To begin with, as suggested in earlier chapters, in crucial portions of high-technology industries, attempts to advance the state of the art are painstakingly slow and expensive because of the limited guidance from science. The development of new alloys with specific combinations of properties proceeds very slowly because there is still no good theoretical basis for predicting the behavior of new combinations of materials. Attempts to improve fuel efficiency are severely constrained by the limited scientific understanding of the combustion process. The development of synthetic fuels is seriously hampered at present by our ignorance of the molecular structure of coal and the relationship of that structure to its chemical properties. The designs of aircraft and steam turbines are both hampered by the lack of a good theory of turbulence. In the case of aircraft, wind tunnel tests still involve substantial margins of error in predicting actual flight performance. Indeed, the high development costs described in this paper are due precisely to the inability to draw more heavily upon a predictive science in determining the performance of new designs or materials. If science provided a better predictive basis for producing optimal designs, development costs (which constitute about two-thirds of total R&D expenditures in the United States) would be far lower.

On the other hand, as was argued in Chapter 7, scientific progress itself has become increasingly dependent upon technology. In advanced industrial societies, an important spur to scientific progress is given by the attempt to account for anomalous or unexpected observations or difficulties that arise in the productive process. In addition, technological progress in the design and construction of scientific instruments has enormously expanded the observational capabilities of science. Our understanding of the remarkably complex molecular structure of polymers, for example, would be far less in the absence of an array of twentieth-century scientific instruments–x-ray diffraction equipment, the ultracentrifuge, the electron microscope, the viscometer, and so on. To an increasing degree, the growing proximity between science and technology is proving to be a powerful stimulus to science, which in turn feeds back into the productive process.

This growing proximity between the scientific and technological realms identifies some important concerns that will require greater attention in the future. Decision makers in both the public and private sectors will need to determine how to improve organizational conditions and incentive structures at the science–technology interface. The ability to improve the functioning at that interface will undoubtedly be an important determinant of future leadership in high-technology industries. This is so not only for the reasons already indicated but because changes also appear to be occurring in science as well as technology. For example, there is evidence that forms of scientific knowledge most likely to be useful to high-technology industries must be pursued in an increasingly interdisciplinary fashion. The transistor was the work of physicists, chemists, and metallurgists. The scientific breakthrough leading to the discovery of DNA was the work of chemists, biologists, biochemists, and crystallographers. Historically, new disciplines such as biochemistry emerged when practitioners of separate disciplines – biology and chemistry – discovered an interesting range of problems at the boundaries of their respective disciplines. Unfortunately, such interdisciplinary research runs counter to the organizational arrangements, priorities, and incentive structures of the scientific professions, although admittedly that is more true in the academic than the industrial world. Nevertheless, there may be a high social payoff to enlarging the opportunities for at least some larger subgroups of the scientific community to define their activities with a stronger problem orientation rather than a discipline orientation, and in ways that will make it easier to undertake joint interdisciplinary research when it appears to be promising.

The most successful research institutions in private industry have already demonstrated that it is possible to conduct both fundamental and interdisciplinary research in a commercial, mission-oriented context. In addition, the United States has, in the past, shown great institutional creativity by inventing public-sector mechanisms for research in specific fields. The land grant colleges and agricultural experiment stations have played immensely important roles in exploiting the regionally diverse agricultural resources of the country; the National Institutes of Health have played a vital part in advancing the frontiers of medical research; and the National Advisory Committee on Aeronautics, the predecessor of the National Aeronautics and Space Administration, played a critical role in generating empirical data for the design of new aircraft that made an essential contribution to American worldwide leadership in the commercial aircraft industry. Devising additional ways of encouraging a closer and more creative interaction between science and technology seems to be both feasible and in close conformity with our pragmatic traditions.

Mr. **Walgren**. Let us go to Dr. Klein.

[The biographical sketch of Dr. Klein follows:]

LAWRENCE R. KLEIN

Lawrence R. Klein is the Benjamin Franklin Professor of Economics and Finance of the University of Pennsylvania and was the founder of Wharton Econometric Forecasting Associates. He is presently chairman of the advisory committee of the new organization, CISI-Wharton International. He is also a principal investigator of Project LINK, an international research group for the statistical study of world trade and payments.

Professor Klein is the author of many articles and books in economics, specializing in econometrics. He is a member of the American Academy of Arts and Sciences, the American Philosophical Society, and the National Academy of Sciences. He has often been an adviser to the U.S. government and many international organizations. He is the holder of several honorary degrees from universities around the world and in 1980 was awarded the Alfred Nobel Memorial Prize in economic sciences.

Dr. **Klein**. Thank you, Mr. Chairman.

It is an honor and pleasure to be here for these important hearings. I didn't prepare testimony. There wasn't time to prepare written testimony; but I did distribute some tabulations.

Essentially, what I want to do is lead you through those to try to explain what I put before you and give my story in those terms. My colleague, Professor Rosenberg, has given us a view of two centuries or more; and I am going to focus on a few decades, essentially the decades since the end of World War II.

That is the way I organized these materials. I think one can say that the present issue that we are discussing is the issue of the economy in transition; and I think it is important to look at the 1970's, the decade we have just come through, as a transitional type of decade in which we made a transition from being energy-inefficient to becoming energy-efficient, not that we have completed that road, but we have come very far along that road.

Many, but not all, the difficulties and the turbulence of the 1970's are associated in the economic sphere with our having had to make that conversion to becoming more energy-efficient, and, hopefully, this will become a fairly permanent part of our economic structure. That, of course, depends on what happens to prices and what happens to relative prices, in particular, for energy, whether we go back to some of our old ways of consuming energy, since I believe that relative prices have changed in a direction that is more favorable to high energy consumption.

Now, the problems of the eighties are a new kind of transition, and they deal, to a large extent, with the new technologies that Professor Rosenberg referred to, not in specific terms, but as a process of technical improvement.

In this discussion, looking ahead, for the eighties, contrasting it with the three decades since the end of World War II—or three and a half—we should make a very careful effort to separate the cycle from the trend.

The 10-percent unemployment rate today isn't going to last forever. It is not good, but it is a cyclical problem; and we have a trend problem as well, a medium- or a long-term problem, and we shouldn't become too much absorbed in the exact cyclical position of the moment.

If you look at the tables that I handed out, which I have organized into decades, historically, I can explain to you my interpretation of that group of numbers. Manufacturing in the United States grew more than average, particularly in the 1960's.

As we look back on things, the 1960's becomes our golden decade. There was very rapid growth, with very rapid economic improvement. I think that it is also important to look at the category for communication and the services, the ones, in particular, that Professor Rosenberg mentioned—finance, insurance, real estate, wholesale, and retail trade.

Just to fix your attention, the manufacturing line is line 14 (page 63) on the table; and the finance, insurance, and real estate line is line 37; wholesale and retail trade are on line 41. You can see, if you will look at the top row, giving the rate of growth of real output in industry as a whole, or the economy as a whole, you see what I mean by the remark that manufacturing in the 1960's grew faster than the average, held to the average in the seventies, and finance insurance and real estate grew faster than the average, both in the fifties and the sixties, also in the seventies.

Wholesale and retail trade did better than the average in the fifties and sixties, and kept up to the average in the seventies.

Now, the one sector I want to focus on, because it is part of the new technological revolution and part of the center of the high-tech sector, is communications, which is line 20. I think it is worthwhile to notice that that was a fast-growing sector already.

We are concerned about it in the future and about its absorption of employment, but it is worthwhile noting that it exceeded the average by far in the 1950's, 1960's and 1970's.

There are two other remarkable things that one should note. First, government was not a very strong growth sector. I think there is a lot of misconception on that issue. There is a measurement problem; but you can see production in government was in a relative sense on the low side historically.

The other thing to notice is that one might have written off the coal industry with negative growth in the 1950's; and for reasons that are quite familiar and well known to all of us, coal has revived.

I think in looking at what is going to happen in the future, as we go through a technological change, that must be kept in mind. There are going to be a lot of surprises. There are going to be reversals of position in an industry or a sector that we may write off. It may suddenly come back into prominence.

Now, within manufacturing, although we have seen this favorable trend above average in the 1960's, and up to the average in the 1970's, there are great differences. For example, lumber, if you look on the next page (page 64) at line 5, grew very strongly in the 1950's and in the 1960's. That was primarily because of the big housing boom that occurred then. Aluminum and steel were high; and also cars, or automobile production, which you can see on line 17. Motor vehicles, had a very high rate of growth, particularly in the 1960's.

In nondurables, textiles had the great age of the synthetics for very fast-growth in the 1960's. Chemicals and rubber, which was probably associated with cars, were also strong; and in the transportation sector, both motors and transportion were strong.

These are just some highlights of what happened in the last few decades. What about the future? In many respects, that is what these hearings are about. How do we plan for future restructuring of industry?

The question is what do we learn from the past?

In order to give you the future—the past is just a tabulation of data, well-organized to get this kind of perspective. But for the future, there are complications. It can't be explained in all details except to say this is the projection from a statistical model of the American economy that we regularly use for such projections, that the structure of this system has a very big inter-industry flow component known as input/output tabulations, which show the relationships of the different parts of the economy to each other; and takes strong account of relative price movements. As relative prices change, then industries change in the degree of activity.

Those were the signals we used in order to show how different industries will prosper and take their place in this array.

And, of course, we have to have an input from the tax system, the budget system, the Federal Reserve and the overseas outlook. All of these are inputs. This is the best judgment of the Wharton econometrics group for the decade of the 1980's.

Now, what do we see? What kind of a transitional economy should we look for; and particularly, how will we absorb these new technologies?

I think one thing that should come out of this is that there is not a great break. There is not a disaster suddenly flooding the streets with unemployed, or suddenly seeing the vanishing of an industry.

The economy moves gradually. This, of course, is not a projection through a century. This is only moving through a decade; but change in the American economy takes place in a serial fashion; and in doing so, we have gradual change.

For the future, according to these tabulations (page 65), we expect that mining will be down, particularly petroleum mining. It simply is a fact of life that we and experts in the field don't think that there is much more to be produced.

It would be produced by virtue of the demand, if it were available, but so far we think that it is running out in a relative sense. There is a sector in here called synthetic fuels, but that does not really come on stream until mid-decade. So those numbers aren't tabulated. Transportation is on the low side; agriculture is not in any kind of decline, but it is not in strong growth.

American agriculture could be growing very vigorously, but there are deliberate slowdown policies, like the one that is in process now, to hold back production in order to maintain price. That is one of the reasons why we have a relatively slow growth for the agricultural sector built into this projection.

Now, manufacturing holds its own, up to the average of industry as a whole; so in looking at technical change and the technical revolution, there is no indication as we look at the situation, that manufacturing is going to vanish.

It is going to be a different manufacturing, but there will certainly be as much manufacturing there, we think, as in the past; and I indicated earlier that communications was a sector that grew very strongly.

That is the heart of the information industry; and it is expected to outperform the rest in the future.

The other areas that Professor Rosenberg mentioned are part of the service sector—finance, insurance, real estate—is very strong; but trade, wholesale and retail trade, is not especially strong as it was in the decades leading up to the seventies.

Government activity is projected on a much lower pace. Now, within manufacturing, we have an estimate that primary metals will be on a more moderate growth path; lumber will be somewhat up.

Electrical machinery, which is the hardware sector for much of the new technology, is not enormously strong, according to this projection, but it is just about at average.

The motor vehicle industry is fairly strong, and nonelectrical machinery is strong.

Now, in the case of the motor vehicle industry, I think it is very important to separate the cycle from the trend and the calculation for the 1980's starts out from a recessionary basis, and there will be a cyclical recovery.

We can see it already in the last few months. That is expected to continue. It means that that part of the smokestack industry hasn't vanished; it isn't going to vanish.

There will be a cyclical recovery; and in many of these cases, those sectors won't recover to their former predominance, but they will certainly have a good cyclical recovery.

In the nondurables sector—and we noticed that that growth rate is projected to be below the manufacturing average—and textiles and paper would be particular sectors on the low side, but outside the manufacturing sector, air transport would be up; other forms of transportation will not.

That provides a look at production. We are very concerned about people and jobs and employment and unemployment. What do these tabulations say about jobs? Agriculture has been a declining job sector for a long time; and agriculture will continue to grow, though according to the production estimates, not particularly at a strong rate, but we will continue to see a decline in the employment opportunities in agriculture.

Although the big era of decline, which was in the 1950's and 1960's, is over with, decline will continue.

The mining sector was very strong in the seventies for employment, and now is projected to be on the low side and negative.

Although manufacturing, as I indicated earlier, maintained its position in this projection for production, it does not on jobs. One would expect to see big declines in certain sectors of manufacturing, in particular one of the declines would be in primary metals; and many of the nondurable lines.

In fact, if you go down the right-hand column, we have a whole string of negative values in the nondurable lines. Those are the sectors where one would expect the automated processes to be very important, and people will be displaced. So what we mean by the economy in transition is literally having people move in a transitional state from one type of activity to another; and that really is much of our economic problem.

At the end of Professor Rosenberg's presentation, he said maybe our problem with technology is macroeconomic; and I would like to take issue with him on that matter.

I don't really think it is macroeconomic. I think the cyclical problem will do only so much; and in this projection, there is a cyclical recovery. But we have still got the microproblem, the distributional problem, how to shift people from these industries where we think there is going to be less need, into the new industries?

I regard that as a structural problem, or as a distributional problem, or as a microeconomic type problem. Another interesting thing about this tabulation is that the service industries, which are the targets for much of present discussion, seem to be providers of jobs; and the transition will be to a large extent, according to this forecast, from some of the manufacturing industries into the service industries.

We don't have a strong Government sector. We have a Government sector which didn't grow in production, faster than average, but grew faster than the average as far as employment is concerned, historically.

We project now that Government will grow on a less rapid pace in the future than for industry as a whole.

The final tabulation that I handed out deals with productivity. It is a combination of the other two.

Mr. **Walgren**. Which is that?

Dr. **Klein**. It would be the final table (page 66). The final table gives real output per person, across industries and for industry as a whole; and if you look at the top, you can see the phenomenon that is very important—Professor Rosenberg pointed it out—the decline of productivity growth, not the decline of productivity, but the decline of productivity growth during the 1970's.

Now, the the hopeful aspect of these tabulations is that for the 1980's, we expect to see some recovery of productivity, not a very strong recovery, but nevertheless, a recovery. In manufacturing, recovery might look quite good, at 2.6 percent, and stronger than the average, but far below the productivity growth of the 1960's.

I would like to refer you to the diagrams; they tell an interesting story as well. They are grouped together on a much more aggregative basis; and what I have placed on these diagrams is a curve. A solid line gives the rate of change of production and a dashed line shows the rate of change of employment. History goes up to the vertical line, and beyond the vertical line is a projection.

One aspect of the projection that you can see on the top graph for durable manufacturing (page 67) is that we have assumed that in looking ahead for a decade, there will be some cyclical activity.

We will have the normal kind of business cycle pattern; production change may go very low or even negative in future years.

You cannot expect to go through a whole decade on a smooth continuous growth path. I think that has been one of the most serious problems of our present administration's planning. They never plan for cyclical disturbance, and that accounts for so much of our budgetary problem at the moment.

We don't know exactly when the cycle is going to occur, but I think we can feel fairly confident that there will be a cycle.

And in this respect, in looking at jobs and productivity, it is significant to see that when we are at a high point of the cycle in the past—and also in the projection—there is a big spread between the solid line and the dashed line, meaning productivity is very high; and at the bottom point, productivity gets rather low.

The solid line and the dashed line converge toward each other. So that in looking ahead for the decade of the 1980's, we have to take account of the fact that there will be some cyclical losses in productivity in that period as well, and that is what we have had very severely in recent years.

Now, according to this graph, on the whole, the growth rate of manufacturing production dominated the growth rate of manufacturing employment, although in the 1970s, it was narrow. That is the decline in productivity. Now, for the projection, you can see graphically that there should be an expected gain in productivity.

If you turn to the next graph (page 68), which is for nondurable manufacturing, you can see that the expected recovery in productivity is even stronger. That would be associated with the concept that the job loss in automation is going to be heavy in the nondurable sector of manufacturing.

The third chart deals with services (page 69), and there you can see—particularly in the projection period—the convergence of the production line and the employment line, which would say that many workers are going to be needed and that productivity is not going to be all that high.

One of our colleagues, Professor Baumol, and his associate have been reported in the media last week to argue that productivity won't recover so much because of the predominance of the service industries. He likens it to the fact that it still takes as many people-hours to produce a Mozart string quartet as it always did.

So there is no saving—no technological saving in that part of the service sector.

In the final batch of charts (pages 71–74), the last four, productivity itself is charted. There we can see very frequent swings in productivity. Those are the cyclical aspects. We can see a recovery of productivity directly in all the sectors that I have delineated separately here; but I think you get a good graphical picture that the recovery in productivity is expected to be fairly moderate. There is a recovery, but it doesn't really get up to the peak points of the history where we cite history from the end of World War II.

Looking at all these numbers, looking at the history, recent history, looking at the prospects, the new industries, the new technologies, what does this tell us about economic policy? The first thing is to get a good cyclical recovery.

We are presumably starting a cyclical recovery now, whether it is good or not is open to question. The goodness being measured in terms of its strength, it is a modest recovery; and as far as jobs are concerned, we will get some help over the decade by demographics; that is to say, the labor force growth in the United States has been slowing down; it is expected to slow down.

So that helps us on one side, but if there is technological displacement through this transitional phase, the introduction of the new technologies, the new industries, and the introduction of the technologies with the low labor content for operation requires that we look at the economic policy to ease the transition period.

Once the transition period has been over and the technological change is firmly in place, then I think that the policies should turn toward reducing the workweek. That is to say, if you go through a long sweep of history, as Professor Rosenberg has, we can find periods of 60-hour workweeks, 40-hour workweeks, and a transition from a 6½-day to a 6-day week to a 5-day week; and we haven't had significant change beyond the 5-day, say, 37- to 40-hour week in a long time; so once the economy has absorbed the transition, once the technological changes are in place, then the time would come to have more leisure or shorter workweeks.

I wouldn't recommend shortening the workweek in a cyclical sense, dealing with the present unemployment problem; but I think it is the kind of measure to think of for the latter part of the decade of the 1980's or in the 1990's.

In looking at the issue that way, it would say there is no reason to fear technological improvement; and one should take the attitude that you can't stop progress and these things are going to come.

But although we don't want to stop progress, we want to deal with it in a humane and efficient way.

Thank you.

[The information follows:]

THE WHARTON LONG-TERM MODEL
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PAGE 1

TABLE 10.00 REAL VALUE-ADDED OUTPUT, AVERAGE ANNUAL GROWTH RATES (PERCENT)

				1951 1961	1961 1971	1971 1981	1981 1991
1	GNP	I	ALL INDUSTRIES	2.7	4.0	3.0	2.0
2							
3	XVGSUM	I	SUM OF REAL OUTPUTS	2.7	4.0	3.1	2.5
4							
5	XVGAG	B	AGRIC. FORESTRY AND FISHERIES	1.1	1.2	1.9	2.2
6							
7	XVGMG	I	MINING	1.1	3.1	1.9	.2
8	XVGMG10	B	METAL MINING	2.4	1.6	.1	-2.7
9	XVGMG11+12	B	COAL MINING	-3.5	2.6	3.6	4.0
10	XVGMG13	I	CRUDE PETROLEUM AND NATURAL GAS	2.3	3.4	1.8	-1.1
11	XVGMG14	B	MINING OF NONMETALLIC MINERALS	3.3	3.4	1.3	1.3
12							
13	XVGMF	I	MANUFACTURING	1.7	4.5	3.0	2.7
14	XVGMFD	I	DURABLE GOODS	1.0	4.6	3.2	3.1
15	XVGMFN	I	NONDURABLE GOODS	2.6	4.3	2.7	2.1
16							
17	XVGRGT	I	TRANSPORTATION	-.1	3.5	1.8	2.1
18							
19	XVGRGC48	B	COMMUNICATIONS	6.2	8.0	7.4	6.3
20							
21	XVGSYN	I	SYNFUELS				
22							
23	XVGRGU49	I	UTILITIES, PRIVATE	6.9	5.9	2.4	1.6
24	XVGRGU491	I	ELECTRIC		6.4	2.9	2.5
25	XVGRGU492	B	NATURAL GAS		4.7	.3	-1.2
26	XVGRGU494.9	B	SANITARY		7.1	6.1	1.4
27							
28	XVGUT491	B	PUBLIC & PRIVATE ELECTRIC		6.2	3.0	2.8
29							
30	XVGCO	I	COMMERCIAL AND OTHER	3.8	4.1	3.5	2.5
31	XVGCM	I	COMMERCIAL	3.8	4.1	3.3	2.6
32	XVGCC	I	CONTRACT CONSTRUCTION	3.7	2.2	-1.1	1.7
33	XVGCCR	B	RESIDENTIAL		5.0	-4.7	3.2
34	XVGCCN	B	NONRESIDENTIAL		-1.0	-.5	.6
35	XVGCCO	B	OTHER		2.7	1.5	1.5
36	XVGFI	B	FINANCE,INSURANCE & REAL ESTATE	4.9	4.2	4.1	3.0
37	XVGSV	I	SERVICES	3.6	4.0	4.4	2.6
38	XVGSV-80	B	NONMEDICAL	3.2	3.4	4.1	2.5
39	XVGSV80	B	MEDICAL	4.9	5.9	5.1	2.9
40	XVGWR	B	WHOLESALE AND RETAIL TRADE	3.0	4.6	3.0	2.3
41	XVGRW	B	REST OF WORLD	4.3	5.4	10.3	.3
42							
43	XVGGV	I	GOVERNMENT	2.2	3.3	1.5	1.6
44	WBCGVG	B	GENERAL GOVERNMENT	2.3	3.3	1.3	1.4
45	XVGGVFE	I	FEDERAL ENTERPRISES	2.4	3.7	1.3	2.2
46	XVGGVFE-491	B	OTHER FED ENTERPRISES		3.4	1.1	2.0
47	XVGGVSE	I	STATE AND LOCAL ENTERPRISES	.5	2.5	3.6	2.5
48	XVGGVSE-491	B	OTHER S&L ENTERPRISES		1.8	3.7	1.7
49			DUMMY INDUSTRIES				
50	XVGOTTM	B	IMPORTS OF GOODS AND SERVICES				
51	XVGOTIVA	B	INVENTORY VALUATION ADJUSTMENT				

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THE WHARTON LONG-TERM MODEL
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TABLE 10.00 REAL VALUE-ADDED OUTPUT, AVERAGE ANNUAL GROWTH RATES (PERCENT)

				1951 1961	1961 1971	1971 1981	1981 1991
1	XVGMF	I	MANUFACTURING	1.7	4.5	3.0	2.7
2							
3	XVGMFD	I	DURABLE GOODS	1.0	4.6	3.2	3.1
4							
5	XVGMFD24	B	LUMBER	-.2	6.3	2.9	3.1
6	XVGMFD25	B	FURNITURE	1.3	3.6	4.0	2.5
7	XVGMFD32	I	STONE, CLAY AND GLASS	1.7	2.9	1.5	2.2
8	XVGMFD324	B	CEMENT		1.4	2.2	1.9
9	XVGMFD32-324	B	STONE, CLAY & GL EXCL CEMENT		3.0	1.4	2.2
10	XVGMFD33	I	PRIMARY METALS	-2.6	2.4	-.2	1.3
11	XVGMFD331+2	B	IRON AND STEEL		4.2	-3.3	2.1
12	XVGMFD3334	B	ALUMINUM		14.3	.5	1.2
13	XVGMFD330T	B	OTHER NONFER. METALS		-1.5	5.3	.3
14	XVGMFD34	B	FABRICATED METAL PRODUCTS	2.0	3.9	2.2	2.4
15	XVGMFD35	B	NONELECTRICAL MACHINERY	.0	4.5	5.4	3.5
16	XVGMFD36	B	ELECTRICAL MACHINERY	5.6	7.2	5.5	2.6
17	XVGMFD371	B	MOTOR VEHICLES	-.9	8.1	1.5	4.4
18	XVGMFD37SP2	I	NONAUTO TRANS EQ + MISC MANU	4.9	2.5	2.3	3.9
19	XVGMFD372.9	I	NONAUTO TRANS EQUIP	5.9	2.1	2.0	4.6
20	XVGMFD372	B	AIRCRAFT		.3	1.0	4.7
21	XVGMFD373.9	B	OTHER TRANS. EQ		5.7	3.3	4.5
22	XVGMFD38	B	INSTRUMENTS	4.2	5.5	6.0	4.3
23	XVGMFD39	B	MISCELLANEOUS MANUFACTURING	2.2	3.7	3.1	1.7
24							
25	XVGMFN	I	NONDURABLE GOODS	2.6	4.3	2.7	2.1
26							
27	XVGMFN20	B	FOOD AND BEVERAGES	2.5	3.2	2.7	2.1
28	XVGMFN21	B	TOBACCO	1.8	1.5	1.4	1.9
29	XVGMFN22	B	TEXTILES	.7	7.0	1.6	1.9
30	XVGMFN23	B	APPAREL	1.1	2.7	3.3	2.2
31	XVGMFN26	B	PAPER	2.2	4.3	2.5	1.8
32	XVGMFN27	B	PRINTING AND PUBLISHING	3.1	3.4	2.4	1.9
33	XVGMFN28	I	CHEMICALS	5.6	6.9	4.0	2.4
34	XVGMFN281+5	B	ORGANIC AND INORGANIC		6.0	-1.9	1.4
35	XVGMFN280T	B	OTHER		7.4	6.0	2.6
36	XVGMFN29	B	PETROLEUM	3.6	3.9	.1	1.2
37	XVGMFN30	B	RUBBER	2.2	7.0	3.6	3.0
38	XVGMFN31	B	LEATHER	-.7	.3	-.3	1.8
39							
40	XVGRGT	I	TRANSPORTATION	-.1	3.5	1.8	2.1
41							
42	XVGRGT41	B	LOCAL AND HIGHWAY PASSENGER	-5.1	-2.8	-.7	1.5
43	XVGRGT42	B	MOTOR FREIGHT AND WAREHOUSING	5.0	5.5	2.5	2.2
44	XVGRGT40	B	RAILROADS	-[illegible].0	.6	-.9	1.9
45	XVGRGT44	B	WATER	-2.6	1.2	2.8	.6
46	XVGRGT45	B	AIR	10.5	11.2	3.2	2.8
47	XVGRGT46	B	PIPELINE	4.4	6.6	2.5	.6
48	XVGRGT47	B	TRANSPORTATION SERVICES	-1.5	1.0	3.5	2.2

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TABLE 12.00 EMPLOYMENT, AVERAGE ANNUAL GROWTH RATES (PERCENT)

				1951 1961	1961 1971	1971 1981	1981 1991
1	NEHT	I	ALL INDUSTRIES	.93	1.90	2.38	1.59
2							
3	NEHA	B	FARM	-2.540	-4.177	-.077	-.074
4	NEETTMG	B	MINING	-3.187	-.980	6.395	-.016
5	NEETTMF	I	MANUFACTURING	-.041	1.325	.803	.163
6	NEETTMF	I	DURABLE GOODS	-.021	1.606	1.312	.507
7	NEETTMFD24	B	LUMBER	-3.420	.854	-.003	.271
8	NEETTMFD25	B	FURNITURE	.287	2.398	.522	.316
9	NEETTMFD32	B	STONE, CLAY AND GLASS	-.086	1.028	-.101	-.619
10	NEETTMFD33	B	PRIMARY METALS	-1.709	.627	-.435	-1.404
11	NEETTMFD34	B	FABRICATED METAL PRODUCTS	.193	2.281	.734	.090
12	NEETTMFD35	B	NONELECTRICAL MACHINERY	-.264	2.496	3.282	1.029
13	NEETTMFD36	B	ELECTRICAL MACHINERY	2.819	1.912	1.835	.739
14	NEETTMFD371	B	MOTOR VEHICLES	-2.862	3.132	-.789	.745
15	NEETTMFD37SP2	B	NONAUTO TRANS EQ + MISC MANU	1.999	-.159	1.382	.938
16	NEETTMFD39	B	MISCELLANEOUS MANUFACTURING	-.707	.852	-.024	-2.073
17	NEETTMFD372.9	B	NONAUTO TRANS EQ	3.318	-.581	1.963	1.875
18	NEETTMFD38	B	INSTRUMENTS	1.939	1.877	3.918	1.625
19	NEETTMFN	I	NONDURABLE GOODS	-.066	.964	.086	-.374
20	NEETTMFN20	B	FOOD AND BEVERAGES	-.268	-.053	-.530	-.626
21	NEETTMFN21	B	TOBACCO	-1.336	-1.657	-.977	-.098
22	NEETTMFN22	B	TEXTILES	-3.207	.666	-1.479	-.693
23	NEETTMFN23	B	APPAREL	.060	1.008	-.760	-.738
24	NEETTMFN26	B	PAPER	1.637	1.266	.086	-.870
25	NEETTMFN27	B	PRINTING AND PUBLISHING	1.798	1.656	1.591	-.056
26	NEETTMFN28	B	CHEMICALS	1.595	2.011	.917	.122
27	NEETTMFN29	B	PETROLEUM	-1.350	-.388	1.051	-.704
28	NEETTMFN30	B	RUBBER	1.161	4.458	2.403	.542
29	NEETTMFN31	B	LEATHER	-.589	-1.787	-2.466	-1.135
30							
31	NEETTRG	I	REGULATED INDUSTRIES	-.792	1.379	1.426	.558
32	NEETTRGT	B	TRANSPORTATION	-1.675	.692	1.037	.169
33	NEETTRGU49	B	UTILITIES	.904	1.275	2.015	.575
34	NEETTRGC48	B	COMMUNICATIONS	.978	3.269	1.930	1.329
35							
36	NEETTSYN	I	SYNFUELS				
37							
38	NEETTCO	I	COMMERCIAL AND OTHER	2.070	2.406	3.310	2.391
39	NEETTCM	I	COMMERCIAL	2.112	3.518	3.453	2.405
40	NEETTCC	B	CONTRACT CONSTRUCTION	.812	2.623	1.207	1.953
41	NEETTFI	B	FINANCE,INSUR,REAL ESTATE	3.230	3.446	3.461	2.397
42	NEETTSV	B	SERVICES	3.226	4.468	4.654	3.189
43	NEETTWR	B	WHOLESALE AND RETAIL TRADE	1.528	3.078	2.960	1.745
44	NEHNSE	E	SELF-EMPLOYED WORKERS, NONAG	.836	-1.676	2.910	2.063
45	NEHNUF	E	UNPAID FAMILY WORKERS, NONAG	5.252	-2.002	-2.873	-1.959
46	NEHNWS-ET	E	CONCEPTUAL DIFF, HH VS ESTAB	-6.351	10.554	3.654	.291
47							
48	NEETTGV	I	GOVERNMENT	3.009	4.130	2.207	1.177
49	NEETTGVF	B	FEDERAL	-.100	1.694	.278	1.313
50	NEETTGVS	B	STATE AND LOCAL	4.447	4.896	2.668	1.148

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TABLE 13.00 REAL OUTPUT PER PERSON, AVERAGE ANNUAL GROWTH RATES (PERCENT)

			1951 1961	1961 1971	1971 1981	1981 1991
1	GNPPP I	ALL INDUSTRIES	1.8	2.1	.6	1.0
2						
3	XAGPP	FARM	3.8	5.6	2.0	2.3
4						
5	XMGPP	MINING	4.5	4.1	-4.2	.3
6						
7	XMFPP	MANUFACTURING	1.7	3.1	2.2	2.6
8						
9	XMFDPP	DURABLE GOODS	1.0	3.0	1.9	2.6
10						
11	XMFD24PP	LUMBER	3.4	5.4	2.9	2.8
12	XMFD25PP	FURNITURE	1.0	1.2	3.4	2.2
13	XMFD32PP	STONE, CLAY AND GLASS	1.8	1.9	1.6	2.8
14	XMFD33PP	PRIMARY METALS	-.9	1.8	.2	2.7
15	XMFD34PP	FABRICATED METAL PRODUCTS	1.8	1.6	1.5	2.3
16	XMFD35PP	NONELECTRICAL MACHINERY	.3	2.0	2.0	2.5
17	XMFD36PP	ELECTRICAL MACHINERY	2.7	5.2	3.6	1.9
18	XMFD371PP	MOTOR VEHICLES	2.1	4.8	2.3	3.6
19	XMFD37SP2PP	NONAUTO TRAN EQ + MISC MANU	2.9	2.7	.9	2.9
20	XMFD38PP	INSTRUMENTS	2.2	3.6	2.0	2.6
21						
22						
23	XMFNPP	NONDURABLE GOODS	2.7	3.3	2.6	2.5
24						
25	XMFN20PP	FOOD AND BEVERAGE	2.8	3.2	3.2	2.7
26	XMFN21PP	TOBACCO	3.2	3.2	2.4	2.0
27	XMFN22PP	TEXTILES	4.0	6.3	3.1	2.6
28	XMFN23PP	APPAREL	1.0	1.6	4.1	3.0
29	XMFN26PP	PAPER	.5	3.0	2.4	2.7
30	XMFN27PP	PRINTING AND PUBLISHING	1.3	1.7	.8	2.0
31	XMFN28PP	CHEMICALS	3.9	4.8	3.1	2.3
32	XMFN29PP	PETROLEUM	5.1	4.3	-.9	1.9
33	XMFN30PP	RUBBER	1.0	2.4	1.1	2.5
34	XMFN31PP	LEATHER	-.1	2.2	2.3	3.0
35						
36	XRGPP	REGULATED INDUSTRIES	3.4	3.8	2.3	3.2
37						
38	XRGTPP	TRANSPORTATION	1.6	2.8	.7	1.9
39						
40	XRGC48PP	COMMUNICATIONS	5.2	4.6	5.4	4.9
41						
42	XRGU49PP	UTILITIES	5.9	4.5	.3	1.0
43						
44	XCOPP	COMMERCIAL AND OTHER	1.7	1.6	.2	.1
45	XCCPP	CONTRACT CONSTRUCTION	2.8	-.4	-2.3	-.2
46	XFIPP	FINANCE, INSURANCE & REAL ESTATE	1.6	.8	.6	.6
47	XSVPP	SERVICES	.4	-.4	-.3	-.6
48	XWRPP	WHOLESALE AND RETAIL TRADE	1.5	1.4	.1	.5
49						
50	XGVPP	GOVERNMENT	-.8	-.8	-.7	.4

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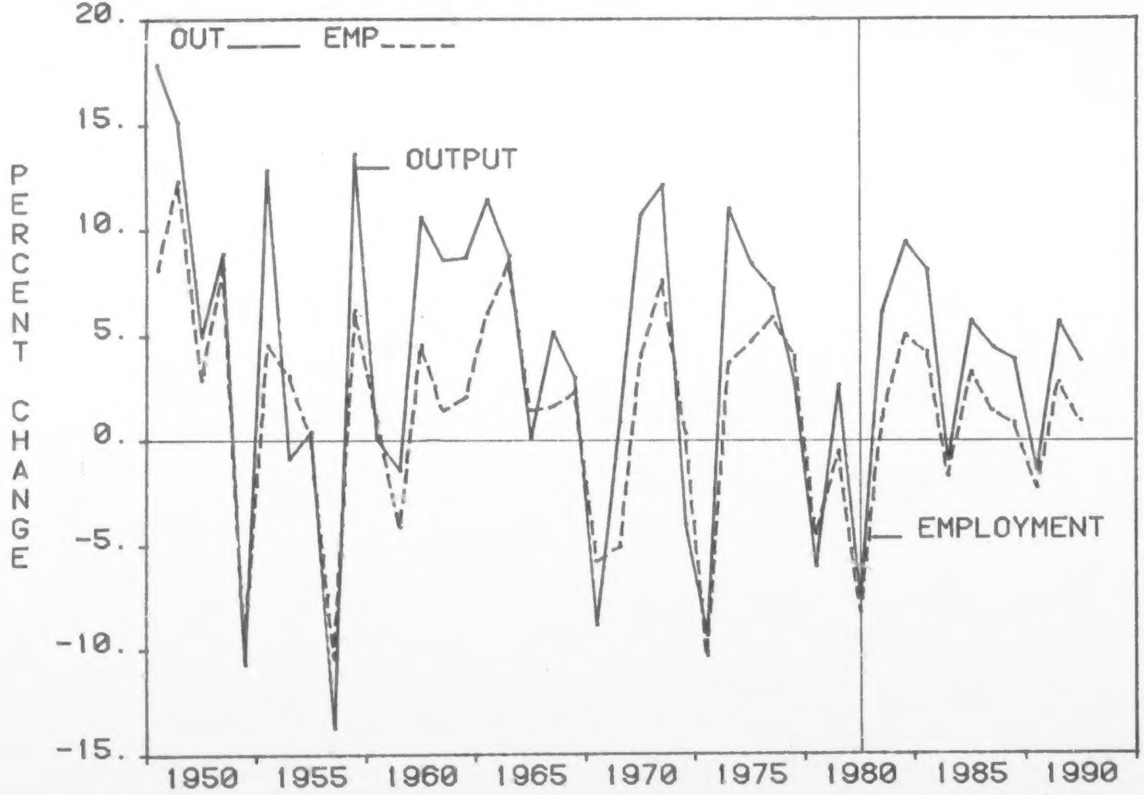
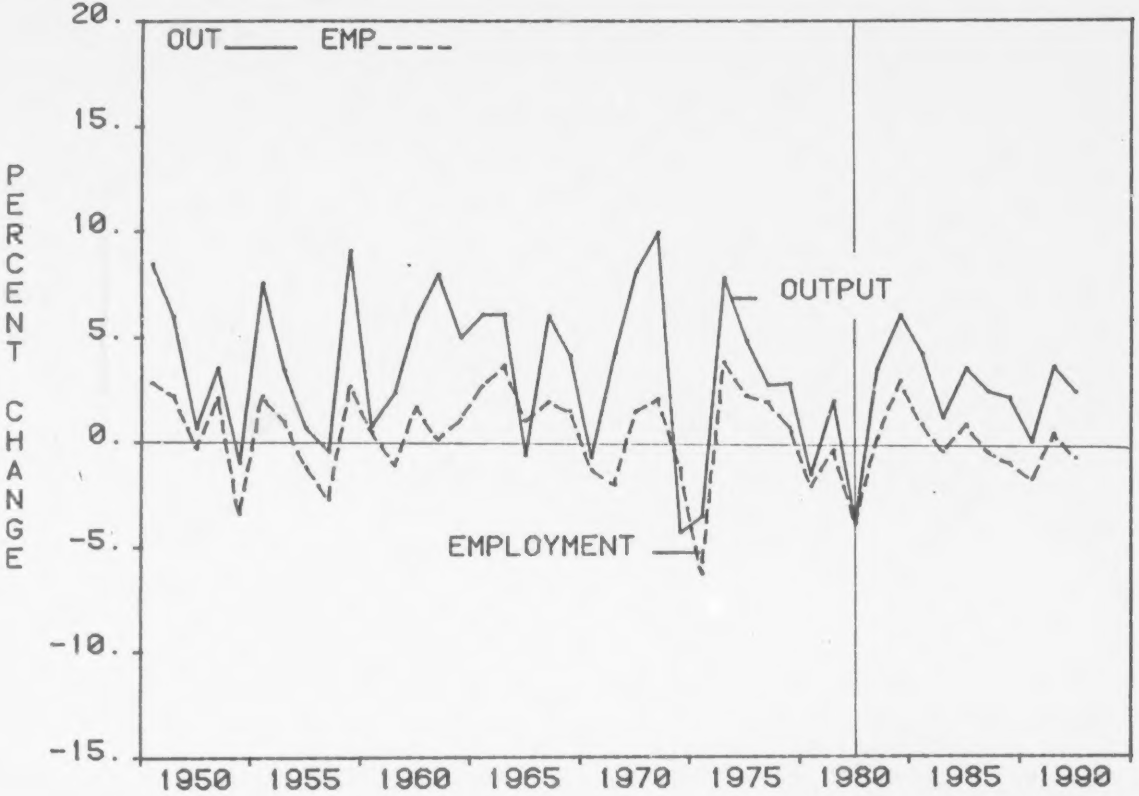
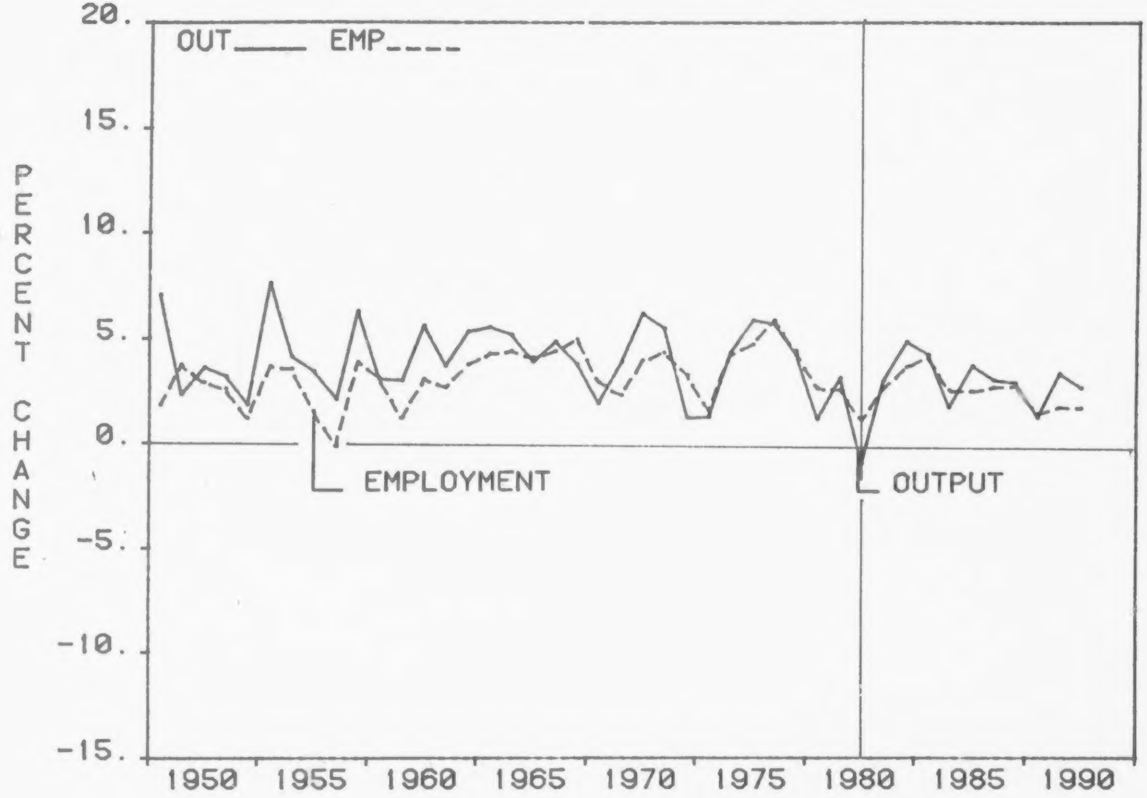
OUTPUT AND EMPLOYMENT GROWTH RATES: DURABLE MANUFACT.
WHARTON LONG-TERM MODEL, JUNE 1983



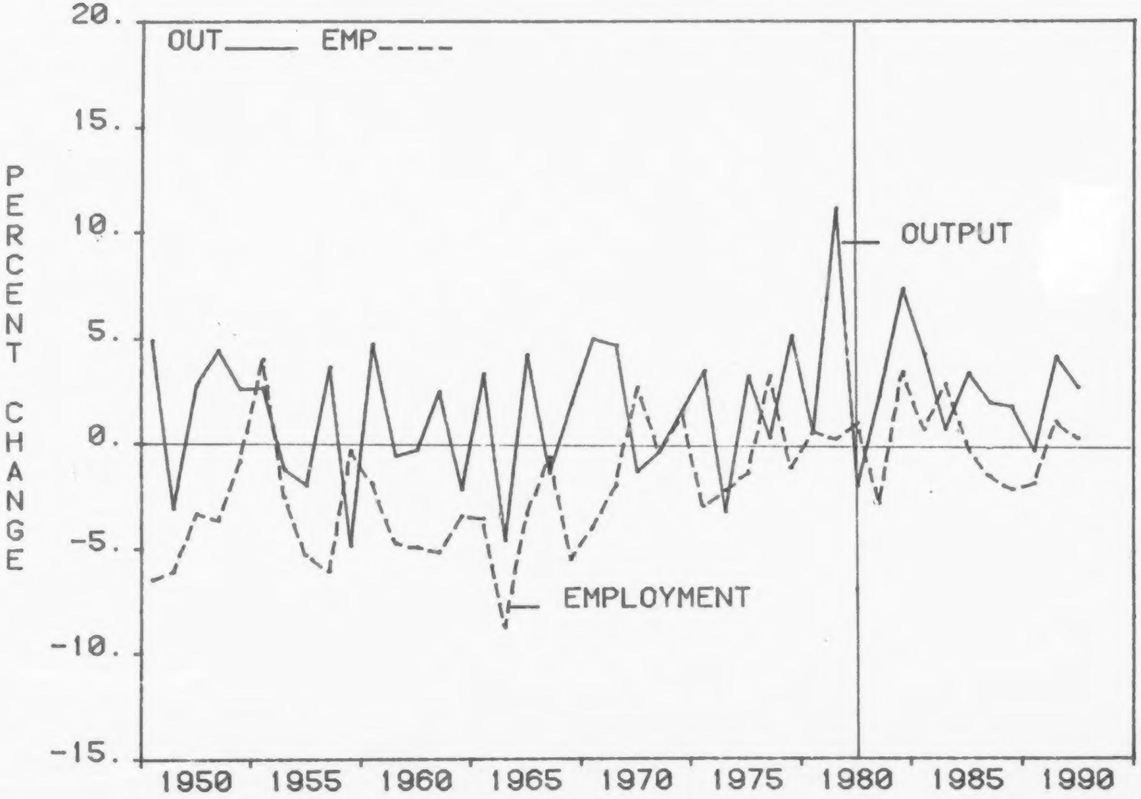
OUTPUT AND EMPLOYMENT GROWTH RATES: NONDURABLE MANUFACT.
WHARTON LONG-TERM MODEL, JUNE 1983



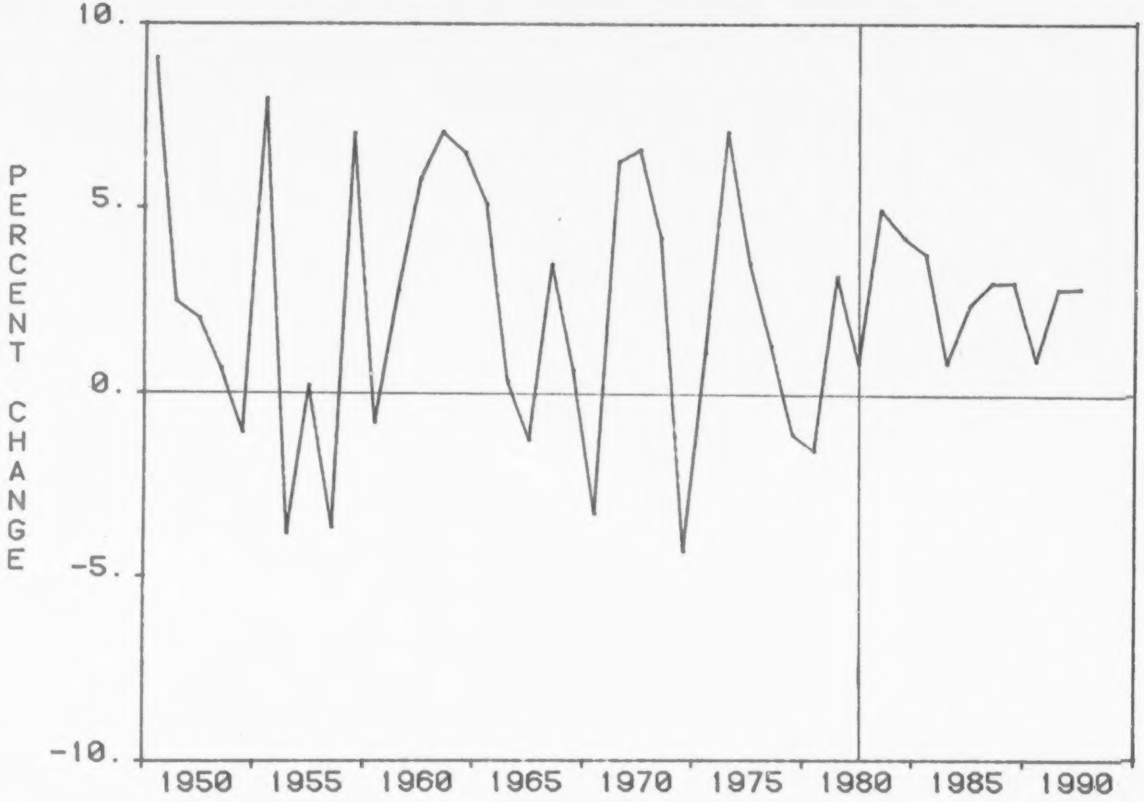
OUTPUT AND EMPLOYMENT GROWTH RATES: SERVICES
WHARTON LONG-TERM MODEL, JUNE 1983

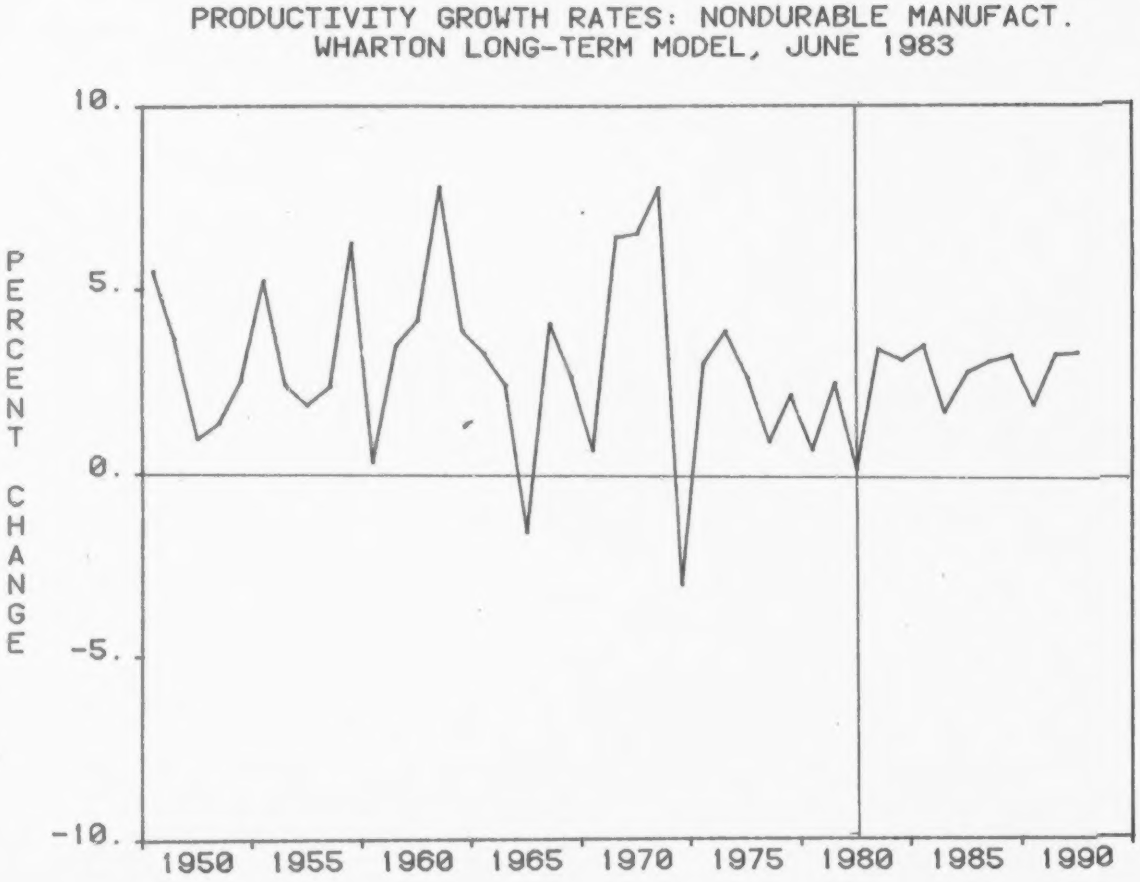


OUTPUT AND EMPLOYMENT GROWTH RATES: AGRICULTURE
WHARTON LONG-TERM MODEL, JUNE 1983

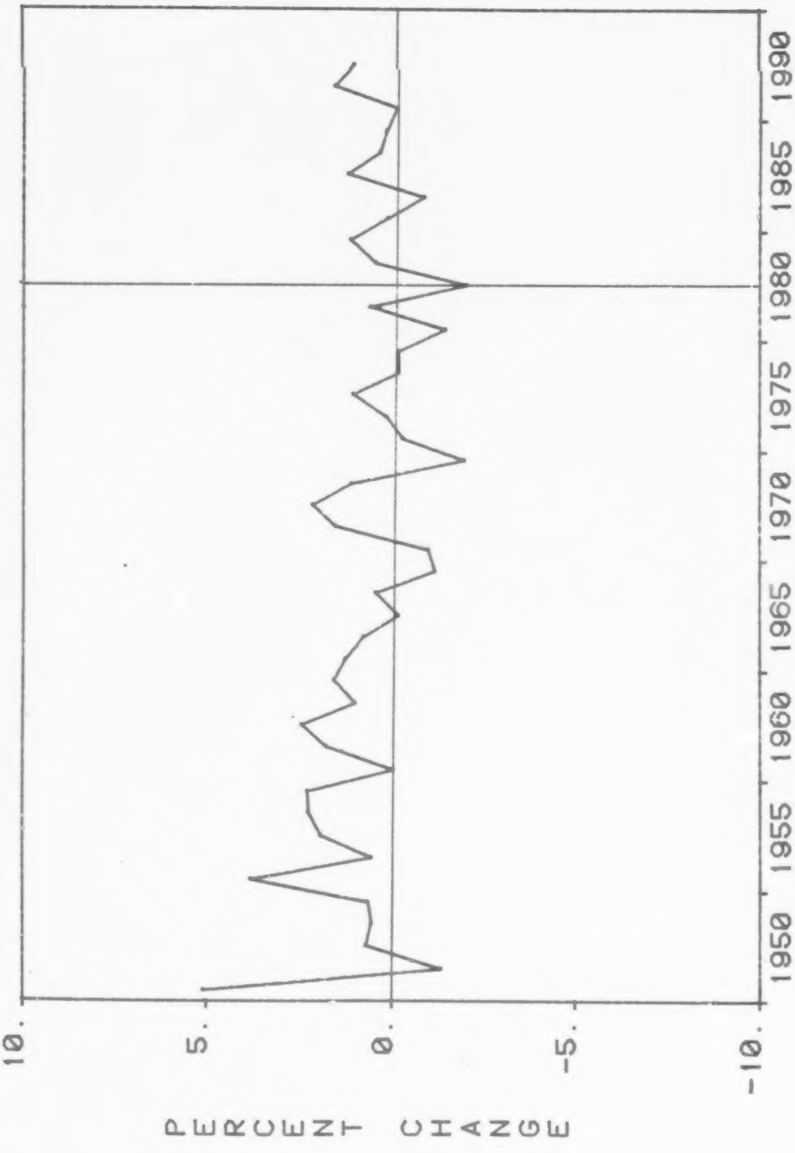


PRODUCTIVITY GROWTH RATES: DURABLE MANUFACT.
WHARTON LONG-TERM MODEL, JUNE 1983

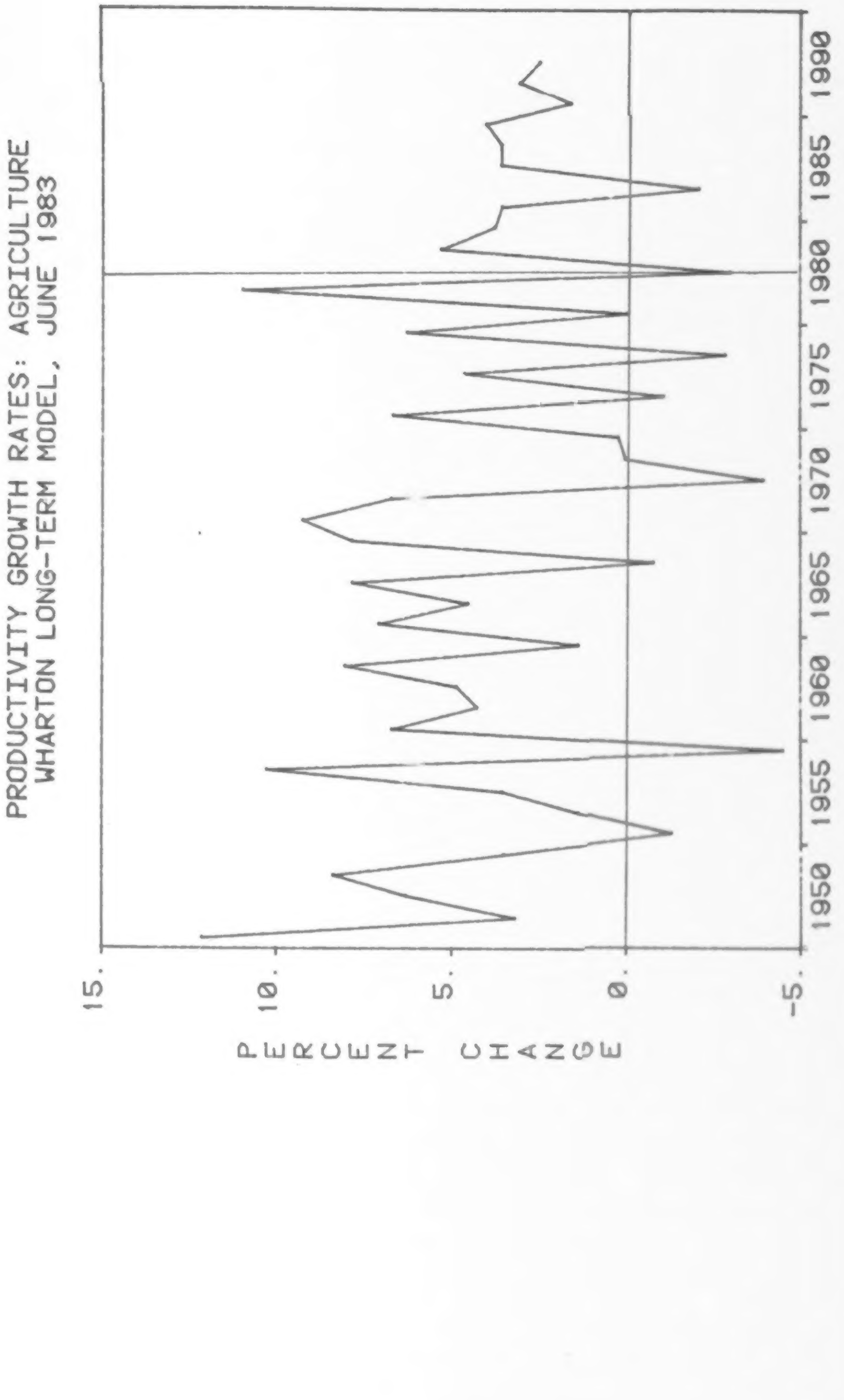




PRODUCTIVITY GROWTH RATES: NONDURABLE MANUFACT.
WHARTON LONG-TERM MODEL, JUNE 1983



PRODUCTIVITY GROWTH RATES: SERVICES
WHARTON LONG-TERM MODEL, JUNE 1983


PRODUCTIVITY GROWTH RATES: AGRICULTURE
WHARTON LONG-TERM MODEL, JUNE 1983
PERCENT CHANGE
15.
10.
5.
0.
-5.
1950
1955
1960
1965
1970
1975
1980
1985
1990

Mr. **Walgren**. Thank you very much, Dr. Klein.

Economics, particularly the large scope of the problem, is difficult to deal with in terms of the timeframe of congressional hearings. I think it important to have taken the time that we did in going over that ground; but let me turn to members for brief comments and some questions.

We have three other witnesses this morning and so, our time is substantially constrained.

Mr. Lundine.

Mr. **Lundine**. Dr. Klein, do you think that the role of Government, particularly with respect to technology policy, would make any difference in your models?

Dr. **Klein**. Well, it certainly could as far as managing the transition is concerned. First, people are going to be technically displaced. If the recovery of the economy doesn't bring down the unemployment rate very far, then there is certainly going to have to be a major role of Government in easing that transition.

That means, retraining schemes, or training for the new technologies of the next generation of the labor force. It means unemployment compensation. And it means phasing out the industries that are—or the companies that are hurt in a way that does not lead to complete bankruptcy—not a complete collapse.

The other aspect is this: We are in a fierce international competition. There is no point to deny that. We have slipped in the rate of growth of productivity. The numbers show that.

Therefore, I think the Government can do a lot by redirecting activity toward those parts of the economy where we can fight for our position in the world trading system in terms of leadership. First, there should be very strong support of R&D, strong support of basic scientific research, and a background, a Government background in which venture capital will be available for firms that want to go into the new areas of high technology. Finally, I believe, though this is highly debatable among the economics profession, I believe in directing investment tax credits and other kinds of investment stimulus schemes to those areas where we deem there is going to be great prospects for the future.

Mr. **Lundine**. You said unemployment was a cyclical problem. You certainly didn't mean to suggest there is not some structural aspect? It seems like in every recovery the lingering rate of unemployment is higher than the last one.

Dr. **Klein**. That is the structural aspect.

Mr. **Lundine**. I thought that is what you were saying. It was not entirely clear.

One further question, Dr. Rosenberg. First, you talk about a lot of the transition to the service economy. Without a strong industrial sector, do you think that there is likely to be a strong services sector; and second, doesn't technology impact on services as well as on manufacturing?

Dr. **Rosenberg**. Oh, certainly. Certainly. In fact, it is usually assumed—Professor Klein referred to Professor Baumol's recent statements. There seems to be some notion that the service sector is inevitably a purely labor-intensive kind of activity.

That certainly is not true. The service sector includes—it is a big grab bag. It includes a wide range of activities. Those activities include some highly professional kinds of activities with all kinds of extremely sophisticated scientific techniques and technical instrumentation.

Consider, for example, what goes on in the health sector, where instrumentation, the use of computer technology is playing a major and an increasingly important role.

I quite accept the thrust of your question that what is going to happen in the service sector and its performance in the future is going to depend very heavily upon technological innovation, upon innovations that we ordinarily think of as taking place in the manufacturing field.

The impact of computers, computerization, is going to be very pervasive in its impact. It already has been to some extent in the service sectors.

Mr. **Lundine**. Thank you, Mr. Chairman.

Mr. **Walgren**. Mr. Skeen.

Mr. **Skeen**. Mr. Chairman, I want to say, too, that I am not going to take much time, because I know the time constraints. The way we have held these hearings on productivity are very interesting, because it gives us time in between—we have had some earlier panels in regard to this, I think just our own subcommittee.

It gives you a lot of time to mull these things over. Then you are exposed to another dissertation on it, and it is interesting, because you begin to pick up threads. Both of you have done an outstanding job of depicting the interest.

It all boils down to a lot of what is going to happen in the future; why has our productivity lagged? As a country that had one of the highest individual productivities of any country in the world, and I think you outlined today what happened to it.

When we added 20 million-plus jobs in the seventies, I think it reduced the individual productivity somewhat because of the large job spectrum expanding.

Increasingly, you keep hearing what in the future, the employment sector is going to depend on. Because our population is still increasing, it requires more jobs than ever before, every decade.

I have been very interested in the models that you have, Dr. Klein. Both of you alluded to this business of shorter working hours for jobs, plus in one of the earlier hearings and panels, we heard a lot about job-sharing.

Does this fit your view of what is going to happen in the future? It bothers me a great deal, because I fail to see that this is going to be any real answer in providing more jobs or reducing appreciably the percentage of unemployment.

It worries me somewhat, because maybe I just don't understand it. If each of you could give me your comments on job-sharing and shorter workweek, how it fits into producing or increasing the productivity, I would appreciate it very much.

Dr. **Rosenberg**. Well, I can make some comments briefly on that. I feel job-sharing is quite appropriate, if it is something that people genuinely seem to have a strong preference for. Of course, the most noticeable, conspicuous aspect of the last 10, 15 years or so has been that the labor force participation rate has, in fact, been increasing.

There seems to be an increased desire to get into the labor market and earn income for an increasingly wide range of purchases. I am not sure how I would favor introducing the shorter workweek if people did not actually prefer that shorter workweek.

I think I would be very skeptical about the idea of legislating something like that, for example. But I am not sure Professor Klein meant to suggest anything like that.

Dr. **Klein**. Well, I want to repeat, in some respects, what I said, that there are two aspects of the job-sharing, shorter workweek issue. One deals with the present high rate of unemployment and the recession.

There, I would say there should be no attempt to introduce job-sharing or shorter workweeks. We should be onto a vigorous recovery with our present workweek and present job activity per person.

But after we make that recovery, I think we should try to get productivity up again, and share in some of those gains of productivity among all segments of our society. That could be done, not through any legislation, but just through a transition to a social norm in which the workweek is no longer 37 hours, but it might be 35 hours or something between 30 and 35 hours.

That would be something that we accept or something that would show up in the standard labor bargaining agreement; but the idea of having a shorter workweek in order to deal with the recession is not a suitable idea. It is only for the long-term gains.

Mr. **Skeen**. From what I read on these graphs, it would seem to me that the only time we ever reach an optimal situation insofar as our output versus our employment is either when we are going up in the cycle or coming down in the cycle.

I think you pointed that out, because we narrowed the gap between output and employment. That has been a very interesting thing, except in the fields of services which stay pretty much the same, but they trend upwards.

Dr. **Rosenberg**. I would like to interject there, there is a real problem measuring the output of the service sector. The fact of the matter is we really do not know how to do it—I was going to say we don't know how to do it well. I want to say we probably don't even know how to do it badly.

We sometimes give up on the attempt to try. Coming back to the string quartet referred to before, it still takes the same number of musicians to produce the quartet, but there is a huge difference on the output side. We can record these things and millions of people can listen to a string quartet, although it may be produced with the same number of man-hours.

That surely, in some sense, represents a substantial improvement in the productivity of the service sector.

Mr. **Skeen**. Again, it is a question of how do you take a known situation, cyclical as it is, and dampen it out so that it is not so severe? I notice that always on the upside of these cycles we let output far outdistance the employment; but it doesn't do that on the downside or on the bottom side, which is very interesting.

There may be some way, depending upon these kinds of hearings, to come up with some kind of conclusions as to where there is any way to dampen these out. It is a very difficult situation.

It is through experience, which we have a lot of here, expressed in the dissertations you both gave this morning, do I think we can address this difficult situation.

Thank you very much. I appreciate the education that I received from this testimony, and the thought process that goes into it. It is a very severe problem. I think this is the way to approach the thing.

At least we are aware that Government isn't going to be the answer to all of them. But with the private sector, for example, such as yourselves, we could at least undestand there are some ways that we could approach dampening out these cycles somewhere in the future, particularly if you hook the educational system into this thing.

Thank you, Mr. Chairman.

Mr. Walgren. Thank you, Mr. Skeen.

Mr. Boehlert.

Mr. Boehlert. No questions, Mr. Chairman.

Mr. Walgren. I confess to some frustration in it all. Both of you seem to say that you don't anticipate a sharp break in employment levels. Do you say that with some degree of certainty? How comfortable are you in saying that? Or is that something that really is not able to be concretely projected from the kinds of numbers economists work with?

Dr. Rosenberg. I am not very comfortable with saying it, Mr. Chairman. About all that I would want to insist is that I see no compelling evidence to make me believe that there are things on the horizon now which somehow or other are going to represent something unprecedentedly different from the kinds of adjustments and transitions that we have had to make at the macro level in the past.

It seems to me in a certain sense the burden of proof is on those people to say we are falling off a cliff, in a sense; things are going to be totally unlike they have been in the past.

I don't see anything which persuades me that that necessarily is going to be true. That is certainly not to say we are not going to have to continue to deal with technological unemployment; but we have been dealing with it throughout our entire history.

I don't see there is a new order of magnitude being attached to that problem.

Mr. Walgren. Might there be a regional order of magnitude, different than the past?

Dr. Rosenberg. Certainly, technological change has a very considerable regional incidence. We have seen that. That, too, is an ongoing thing. Over the decade of the 1970's, there was certainly a substantial movement of population to the so-called Sunbelt regions of the country.

Now, whether that geographic kind of movement will have to be more rapid than in the past, that again may be; but I don't see it, obviously, in any of the cards that I am trying to read, that that has to be happening. It is going on. It has been going on.

Dr. Klein. I think the point that Mr. Lundine made, that after every cyclical episode, the level of unemployment gets higher, is very significant. After the end of World War II, when we reached full employment, it was about 2 or 3—2½ to 3 percent unemployment.

In the sixties, 4 percent was the norm. In the seventies, 5 percent. Some people wanted it to go even higher, choosing the bottom point at a higher and higher level, and designating that as full employment.

We are in a recovery. I think this recovery is going to go on, but it is not going to bring us back to 4 percent unemployment. It might bring us back to 6 percent or between 5 and 6, but that still leaves us with a problem to be handled.

So there will be cyclical recovery; and in our State—the Commonwealth of Pennsylvania—we will have some recovery of the steel industry; we will have recovery of the automobile industry or the parts industry; chemicals; but it won't necessarily be a recovery to the same position as in the past.

What is the outlook for that? It probably means that on a regional basis there has to be some reorganization. Many scholars of regional affairs point to the Northeast—the extreme Northeast-New England particularly, the Boston area—as being a region of the country that absorbed the loss of textiles and shoes and other manufacturing industries and went into the high-technology sectors. This kept unemployment very favorable.

There is a big spread between the unemployment rate in Pennsylvania now and the unemployment rate in Massachusetts or the New England areas.

Well, that says that parts of the Northeast or the North Central States have to make a similar kind of adjustment. The industries are going to be different; but this kind of transitional adjustment did take place in the past. It took place in different sectors, i.e., different industrial sectors.

Now it is taking place in sectors that are hitting different regions of the country and we certainly have a problem in Pennsylvania.

Mr. WALGREN. Well, on behalf of the committee, thank you very much for your contributions. We appreciate the presentation. We may be asking you some additional questions for inclusion in the written record.

We appreciate your help. Thank you very much.

The second panel will be made up of David Birch, director of the Program on Neighborhood and Regional Change, associated with the Massachusetts Institute of Technology; Quentin Lindsey, Science and Public Policy Advisor to the Governor of North Carolina; and Dennis Chamot, assistant director for the Department for Professional Employees of the AFL-CIO.

Welcome, gentlemen. We have only about an hour to deal with three people, so it would be helpful if you can summarize your statement. Your written statements will be made part of the record.

Let's start with Dr. Birch and go forward.

[The biographical sketch of Dr. Birch follows:]

David L. Birch

Director, MIT Program on Neighborhood
and Regional Change
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Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Date of Birth: May 6, 1937

POSITIONS

Director, MIT Program on Neighborhood and Regional Change 1976 - Present

Senior Research Scientist, MIT Laboratory for Architecture and Planning, 1974 - Present

Lecturer, MIT Department of Urban Studies and Planning, 1974 - Present

Associate Professor, Harvard Business School, 1970-1974.

Assistant Professor, Harvard Business School, 1966-1970.

Research Associate, Harvard Business School, 1964-1966.

Research Assistant, Harvard Business School, 1963-1964.

Marvin Bower Faculty Fellow, Harvard Business School, 1967-1968.

Research Engineer, California Institue of Technology/Jet Propulsion Laboratory, 1964-1965.

Research Engineer, General Dynamics/Astronautics, 1962-1963.

EDUCATION

AB	Harvard University, 1959
MBA	Harvard University, 1962
DBA	Harvard University, 1966

STATEMENTS OF DR. DAVID BIRCH, DIRECTOR, PROGRAM ON NEIGHBORHOOD AND REGIONAL CHANGE, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; DR. QUENTIN W. LINDSEY, SCIENCE AND PUBLIC POLICY ADVISOR, OFFICE OF THE GOVERNOR OF NORTH CAROLINA; AND DR. DENNIS CHAMOT, ASSISTANT DIRECTOR, DEPARTMENT FOR PROFESSIONAL EMPLOYEES, AFL-CIO

Dr. Birch. Thank you. We have been concerned about how to generate 15 million jobs in the next 10 years. Our approach has been different from some in that we built the economy up from the bottom. We built a file on the history of each of 5.5 million business establishments and followed them over time, one at a time, to see who is and is not creating jobs—rather than coming down from the top.

We found some very interesting things by doing that. We found, first of all, that very few firms migrate long distances. We also found that there is a tremendous turnover in our economy.

We lose something like 8 to 10 percent of our jobs everywhere in the United States and it is very uniform. We are turning over something like 50 percent of our job base every 5 years. There is a tremendous volatility underlying the aggregate numbers that come out of the GNP accounts.

Furthermore, that is a pretty high number. It means at any place in the United States to break even has to replace something like 50 percent of its jobs every 5 years.

That means there is a great opportunity for change. There is a lot of change taking place. It has been described by some, and was this morning, as the shift from manufacturing to services.

As I look at it in micro detail, I am not very happy with that description of it. I think it doesn't really capture what is going on. I would more prefer to think of it as a shift from the use of muscles and dexterity as the basis for what we do to the use of brains as a basis for what we do.

I think the question to ask of any product or service in our economy is: Is there a lot of thinking and innovation involved for successful execution in one form or another? If the answer is yes, there is a good chance it will do well.

If the answer is no, there is a chance it will be taken over by a robot or a foreign employee of some sort. I think there is a tremendous amount of innovation still left in some sectors of manufacturing; printing and publishing, pharmaceuticals, microelectronics, and so forth.

Also, we found in our analysis of individual businesses, manufacturing companies with 20 or fewer employees are growing as fast in the service sector, building on the new technologies, coming up from the bottom as some of the larger ones come down.

Most of the jobs being created in this high-thought-content sector are not in manufacturing. They are medicine, law, engineering, design, computer software. I call this high innovation group thoughtware, because it is based so heavily on thinking and innovation for success.

There are a lot of implications of this, one of which has been alluded to. Making things is less important in our economy than it used to be. We created about 30 million new jobs since 1965, increasing our economy or employment base by 46 percent.

Not one of those jobs has been in manufacturing. We have the same number of manufacturing jobs today as we had in 1965. The share has dropped from 30 to 20 percent. Of those 20 percent, only half are actually making anything. The rest are accountants, salespeople, clerks of some form or another.

We are down to the point where 10 percent of our labor force is involved in making anything. I would suspect from all the numbers we heard from Dr. Klein this morning, that that will drop to 5 or 6 or 7 percent over the next 10 or 15 years, with agriculture dropping to around 2.5 percent.

Another implication of this shift is the greater importance of smaller businesses. The economies of scale are much lower in the thoughtware sector than they are in manufacturing, as John DeLorean discovered the hard way.

As a consequence, the formation rates of new corporations have skyrocketed. In 1950, we formed about 90,000 corporations a year coming out of the war. By 1965 it was 200,000; by 1975, it was 300,000; by 1981, it jumped to 600,000 new corporations starting out a year.

There has been debate over the jobs being created by these smaller businesses, which I find myself in. But as the dust settles, we realize that anywhere from 50 to 80 percent of the new jobs are now being created by smaller firms, firms with 100 or fewer employees. At times and in places it is well over 100 percent. This past year may well have been a good example of that.

Meanwhile, the larger corporations are slowing down. The Fortune 500 we think of as a lively, dynamic force in our economy. From 1954 to 1970, they certainly were, doubling their employment base and dominating world commerce. Since 1970, however, they have actually declined in terms of the jobs they hold. They now employ 250,000 fewer people than in 1970. They employ 450,000 fewer people than in 1969. That includes all their overseas employment expansion, which is on the order of 2 to 3 million jobs. They thus employ somewhere on the order of 2 to 3 million fewer Americans than they did in 1970.

It is also a shift—which has been alluded to—from a national to an international economy. Imports and exports have doubled since 1950 as a percent. The absolute increase has been huge. But most importantly, it has been a shift in the mix.

We used to be in balance on goods and in balance on services. We are now exporting or covering a $40 billion a year deficit in goods, with a $40 to $43 or $44 billion surplus in thoughtware. Our wealth as a nation is now based almost entirely on our wits and not our ability to make an export.

I would like to comment for a little bit on the nonuniformity of this process that has been going on. It is something that concerns me a great deal—both within the United States and comparing the United States to other nations going through the same development.

I have been working with several States and areas in considerable detail lately. They are all responding in very different ways to this transition. Some are blessed much more than others with what it takes to survive in this new economy. It used to be natural resources—harbors, rivers, rails, cheap labor, tax breaks.

Now it is brains, cheap labor, telecommunications facilities, pleasant living environments. It is a gradual shift. I can already see the consequences. Where I come from, in Massachusetts we have been through this transition.

Based on education and the spinoffs from education, we now have one of the lowest unemployment rates in the country. It is now running around 5, 6, or 7 percent. This is a general trend. If you go across the country and look at the places in States with the lowest unemployment rate, they are where the supplies of brains are. This includes Little Rock, San Francisco, San Jose, Athens in Georgia, Minneapolis-St. Paul, Rochester, Columbus in Ohio, Philadelphia in Pennsylvania, Austin, Knoxville, Madison in Wisconsin. All are running substantially below the statewide average in unemployment.

Looked at another way, we lost as a nation 2.3 million manufacturing jobs in the last 4 years. The question is how many of those were replaced in different places?

In the Nation, we replaced every 100 manufacturing jobs lost with 250 thoughtware jobs. We have been more than breaking even on that shift over the last 4 years.

Kentucky, on the other hand, has only replaced 62. Louisville replaced 20 for every 100 manufacturing jobs lost. St. Louis, Congressman Gephardt's district, has only replaced 50 for every 100 lost.

Minnesota, on the other hand, replaced 300; Massachusetts replaced 400; New York City replaced 900; Colorado, which lost manufacturing jobs in the last 3 years, replaced 3,500. In the Boston metropolitan area, with relatively modest manufacturing losses, has replaced every 100 lost manufacturing jobs with 14,000 service-sector jobs.

That strongly suggests that no single set of programs at the Federal level can deal with this diversity of experience. It won't even work within States. You can find very striking differences between Louisville and Lexington, or Memphis and Knoxville, Minneapolis and Duluth, Ann Arbor and Flint, Boston and Fall River—all having different experiences within the same State.

Moving in another direction, we find a great variation across Western nations. I have been working recently with some of our European allies. It is clear they have serious employment problems and that they can't use our solutions any more than we can use theirs.

In the 1970's we created, I count 19 million—somebody else said 20 million—new jobs from a basis of 70. They created 1 million new jobs from a base of 100 million. We were 25 times more productive in creating jobs than the common market nations were.

In the 1980's, as Dr. Klein referred, our growth will slow down to a 15-percent expansion. Theirs, on the other hand, will have to accelerate. By one calculation, they are going to need 10 million new jobs in the next 6 years to reach full employment. They have created only 1 million in the last 10 years.

When we examine their systems carefully, I think we begin to realize that their problems are different from ours. I find it helpful to distinguish in that regard between what I call micro and macro stability. Micro stability is the stability of the individual company and individual job.

Macro stability is the stability of the economy as a whole and its ability to create jobs. There appears to be a real conflict between these two forms of stability. We have accepted a great deal of micro instability—offering little job security to achieve a great deal of adaptation and macrogrowth.

They have chosen a great deal of microsecurity—a great deal of job security, and corporate security—giving up aggregate job creation. Our problem has thus become one of massive displacement, theirs is one of not having enough jobs, period.

Just as it is clear we cannot adopt the same policies across the United States, it is also clear that we cannot solve our displacement problems by adopting European standards of job security and corporate rigidity. These policies are causing the European nations enormous problems. They would cause us even greater ones.

If I step back from all of this, I conclude we are in a period of great transition. Different places and different countries are responding in different ways. Under these circumstances, I am very skeptical of any uniform set of policies that will deal with employment problems. I think for each place helped, uniform policies will probably not help three or four other places, and may actually harm one or two places.

I think it is time for different solutions for different places, so each place can lead with its stronger suit in what is coming down the road.

Thank you very much.

[The prepared statement of Dr. Birch follows:]

Statement Prepared

by

David L. Birch

JOB CREATION IN THE U.S. AND OTHER WESTERN NATIONS IN THE 1980'S

David L. Birch
June 7, 1983

Creating jobs is high up on the agenda for most western countries during the 1980's. We enter the decade with high rates of unemployment, and we face large increases in the number of people who will want to work.

We face these challenges during a period of great transition. The things we have done for the past 100 years are no longer valid as a basis for future growth -- and we must grow to maintain our vitality. Transition means dislocation. It means that workers must stop doing old jobs and learn new ones. It means that companies must contract some operations and start up new ones. It means that many firms will vanish altogether and be replaced by new ones.

As we look ahead, it will be important to understand:

(1) the nature of the changes taking place,

(2) the general implications of these changes for businesses, workers, governments, and buildings, and

(3) the kinds of responses that will be appropriate. It is our basic thesis that the present shifts occurring in our economies have deep cultural roots, and that our responses will be different because of it. At issue are attitudes toward family,

mobility, risk, education, and entrepreneurship that differ considerably between nations, and that will govern to a great extent how we respond to the common challenge we face. We could not pick a more interesting time to look down the road, and to try to understand how our pasts will affect our futures.

Job Creation in the U.S.

A first step to understanding economic change is to base that understanding on the behavior of individual businesses -- not on some set of aggregate measures of national production. The aggregate data are masking most of the "churning" in our economies; during transition, understanding the processes causing change, and not just the change itself, is crucial. We must thus study our economies from the ground up -- business by business.

In the U.S. we have established a file of about 5.6 million business establishments -- about 80 percent of all of them. For each establishment we know, for 1969, 1972, 1974, 1976 and now 1978 and 1980, its sales, employment, industry, ownership, age, and location down to the street address. By comparing these items over time, we can monitor how each business evolves. By adding them all up, we can describe not only what kind of change is taking place, but also how it is taking place.

When we took our first look at the change process, we discovered two striking phenomena we had not expected to find. First, virtually no businesses move their operations long distances -- in the sense of hiring a moving van and relocating. There are many short moves, but few moves from city to city. This surprised us, since our economic literature is filled with anecdotal evidence of industries moving from our North to our South, or from one state to another. We discovered that businesses may move capital (by investing differentially in one location over another) but that their movement of operations is insignificant.

Second, we discovered that, underlying what appeared to be relatively slow changes in the aggregate totals was a set of large flows -- a degree of churning that we had not anticipated. Most places in the U.S. lose about eight percent of their jobs each year through companies either laying off people or going out of business. That means that each place, simply to break even in employment over time, must replace 50 percent of its job base every five years.

Furthermore, we noticed: (1) that, so far as losses go, most places lose at about the same rate, and (2) that what little variation does exist suggests that the healthiest economies have the highest losses. Houston and Dallas lose a greater percentage of their jobs each year than New Haven or Buffalo. Cities that have been blaming high job losses for their economic woes must come to realize that it is not their losses that are unusual, but their inability to replace those losses. Growing areas replace more than 50 percent of their job base every five years and declining ones replace less.

Loss and replacement at this rate offers great opportunity for change -- if the replacements are different from the losses -- and the change is occurring. This change is frequently described as a change from manufacturing to services, which is an unfortunate description for several reasons. First, it is not accurate. Several sectors labeled "manufacturing" are flourishing at the moment, and, according to our data, manufacturers with fewer than 20 employees, as a group, are doing just as well as the service economy. But more importantly, "service" implies a form of inferior work (janitors, guards, hospital workers, fast-food chain workers) that does not capture the essence of what is taking place. As John Naisbitt has pointed out in Megatrends[1], the percentage of jobs in this narrow, demeaning concept of "service" has remained the same for the past 30 years -- at about 11 or 12 percent.

The real shift is not from manufacturing to service, but from reliance on muscles and dexterity to reliance on brains. The question to ask of any product or service today is: Does it require a fair amount of thinking and innovation for its success? If the answer is "Yes", there is a good chance it is growing in the U.S. and providing new jobs. If the answer is "No", there is a good chance it is either moving offshore or increasingly being taken over by a robot. Some of the high-innovation-content jobs are found in companies now labeled "manufacturing" -- in such areas as printing, publishing, pharmaceuticals, electronics, computers, robotics, genetic engineering, etc. Most, however, are not. Most of our growth is now taking place in medicine, law, engineering design, computer softwars, education, distribution, and so forth.

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[1] Naisbitt, John. Megatrends. (Warner Books, 1982)

Another way to look at this same phenomenon is in terms of "product half-life." Product half-life is the time it takes for half the value of a product or service to become obsolete. At one extreme is steel or automobiles or rail roads. They receive a relatively large initial investment which is then amortized over 10 or 15 years, or more. At the other extreme is computer software, which is constantly being replaced through innovation, and has an average half-life of perhaps 18 months. The change we are experiencing is a shift from products and services with long product half-lives to those with quite short half-lives. We refer to this latter group as "thoughtware" because it is so heavily based on innovation and thinking for its success and growth.

Direct Implications

There are several direct implications of this shift which we are already experiencing. First, we are, in fact, employing a smaller and smaller percentage of our labor force to make things. Since 1965 we have created 30 million new jobs and have expanded our work force by 46 percent. Virtually none of these new jobs are in manufacturing. This trend has been going on so long now that only 20 percent of our work force is employed by companies labeled "manufacturers," and of that 20 percent, only about half actually make anything -- the rest are accountants, lawyers, personnel people, managers, sales people, researchers, secretaries, etc. We have thus reached the point where only 10 percent of our labor force makes anything. If 10 percent of these are unemployed, it still represents only one percent of our labor force. All the evidence suggests that this downward trend will continue. Coupled with the fact that only 2.5 percent of our labor force grows things, we may soon reach the point where less than 10 percent of the work force makes or grows anything.

Larger to Smaller Businesses

Another implication is the increased importance of smaller enterprises. There are many fewer barriers to entry in a thoughtware economy. In many fields, two or three people with a small amount of capital can conceive of a new product or service and be in business in a few weeks. One consequence of this is a rapid rise in the annual rate of new business incorporations in the U.S.

In rough terms, the progression has gone as follows:

Year	New Incorporations
1950	90,000
1965	200,000
1975	300,000
1981	600,000

These figures do not include enterprises that form but do not incorporate such as partnerships and self employed people, which are very substantial in their own right.

As the rate of small business formation has increased, so has the contribution of smaller businesses to job creation. Having now studied several periods during the 1970's, we discover that the percentage of jobs attributable to smaller businesses varies considerably from one period to the next -- depending for the most part on how larger businesses perform. In some periods, for example, the share of jobs created by businesses with 100 or fewer employees can be as high as 80 percent. In other periods, it drops off to 50 percent.[1] But it is usually significantly higher than the corresponding share of employment in the economy. In some recent work,[2] we have shown how small firms climbing up the size ladder are offset by larger ones falling down to produce fairly stable shares of total employment by size category.

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[1] Initial analyses by The Brookings Institution indicated shares of net job creation smaller than 50 percent for firms with 100 or fewer employees. This result was due in part to the very short interval being measured and in part to the special problems in the data. More recent Brookings analyses (See Armington, "Further Examination of Sources of Recent Employment Growth Analysis of USEEM Data for 1976 to 1980"; February, 1983) suggest small business shares in the 50 to 80 percent range.

[2] See David Birch, Share of Jobs vs. Share of Job Creation: A Flow Analysis. (MIT Program on Neighborhood and Regional Change, 1983

If this pattern holds, we would expect larger corporations as a whole to be growing slowly as a group and frequently declining as individual firms. This is precisely what we do find. Between 1954 and 1969, for example, the Fortune 500 (our 500 largest industrial companies) doubled their number of employees, giving rise to a diverse literature describing their growth and world wide domination. Between 1969 and 1981, however, the Fortune 500, as a group have declined by 452,000 total jobs. This total includes overseas expansion. The declines in terms of the number of U.S. workers is thus far greater -- on the order of 1.5 - 2.0 million jobs.

Physical to Human Capital

Still another implication of our shift from muscles to brains is a shift in the relative importance of physical and human capital.

Although we must still have buildings and machines to house and produce our national product, the machines (mostly computers) are getting cheaper and we are learning how to reuse our buildings. Meanwhile, we are investing heavily in education and retraining, and are still far behind where we should be -- creating a major national issue.

The issue goes beyond the traditional educational system. As our labor force ages, and as its rate of growth slows down (15 percent growth in the 1980's vs. 25 percent in the 1970's), we find that 90 percent of the 1990 labor force is in the labor force today, and 75 percent of the 2000 labor force is in the labor force today. As we move to an economy based on rapid change and product half-lives of two to three years, it means that virtually all of our labor force must be retrained within the next 10 years, not just the 10 percent new workers that will be added.

This problem is further compounded by the structure of our educational system. Based on tenure and tradition and short work days, it is very slow to change. Furthermore, unlike the past, it cannot afford to replicate in the schools the facilities and technologies found in the work-place today. Robotics and CAT scanners and exotic transactions processing systems are well beyond the reach of any school. Even simple, small computers find their way into schools slowly rather than quickly.

Employers cannot wait. As a result, we are beginning to experience a great expansion in alternative forms of training, ranging from in-house company (and hospital) programs to private consultants offering seminars to major corporate investments like those made by the Control Data Corporation in its Plato system and Control Data Institutes, and now the Control Data Learning Centers -- slated to number in the thousands. Other corporations are striving to improve public education. The Humana Corporation in Lousiville, Kentucky, for example, has adopted a public school in Louisville, and will, at its expense, install a computer for every five students in that school. Other corporations in Louisville are following Humana's lead.

In short, there is a revolution underway in the way in which we provide education and training that is running in parallel with the shift from muscles to thoughtware in our economy. It is not always a graceful revolution. Massachusetts fired several thousand public-school teachers (through the process of Proposition 2 1/2) because the public at large was not satisfied with the job they were doing. But revolutions rarely are graceful -- an issue to which we will return shortly.

National to International Economy

If we grow much more than we eat and make less, it is clear that we must trade more with others to get what we need. And that is exactly what we have done. Our imports and exports have roughly doubled as a percent of our GNP since 1950, and the absolute dollar increase has been huge.

More important, the mix of our trade has shifted. As our manufacturing abilities waned, and our thoughtware flourished, we began to export thoughtware seriously as a basis for paying for the goods we were not making. As Figure 1 illustrates, about 1974 or 1975 we began to switch from being more or less in balance on goods and services trade to being in serious goods deficit, offset by net service exports. The pattern has continued beyond the 1980 cutoff in the figure. We ran about a $40 billion goods deficit in 1982 and managed to more than offset it with a positive service balance to produce our third consecutive year of overall positive balance. According to Joan Spero[1], we now export about $60 billion worth of services a year, and single-handedly account for 20 percent of the world trade in services. Clearly, our wealth as a nation now depends upon our wits and not on muscles.

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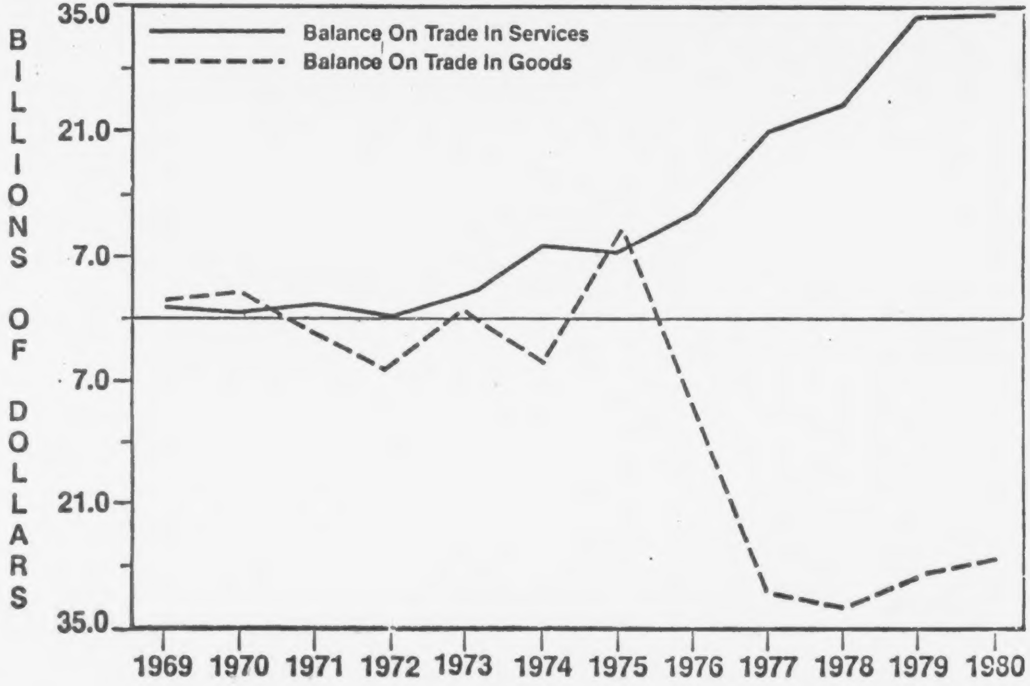
[1] Joan Spero, "Barriers to U.S. Services Trade" (Statement before the Subcommittee on International Finance and Monetary Policy of the Senate Committee on Banking, Housing, and Urban Affairs; November, 1981).

Figure 1

U.S. BALANCE OF PAYMENTS
TRADE IN GOODS & SERVICES



Source: U.S. Dept of Commerce, Bureau of Economic Analysis

Managing Change in Western Nations

It is quite clear that western nations face great economic problems at the moment, and that we are undergoing great change. The question arises: will all countries respond to the crises we face in the same way? We suspect not. Over the past 200 years or so our cultures have diverged. The changes we are talking about are not superficial. They affect directly the cultural traditions of the workers involved -- how they raise families, how they view mobility, how they view education, how they view careers, and so forth. To the extent that our cultures differ, so will our responses.

One way to highlight the differences is in terms of the choice between micro and macro stability. Micro stability is the stability of the individual job and the individual business. Macro stability is the stability of the economy as a whole. The two are, we feel, in inherent conflict. The greater the attempt to achieve micro stability (job security, minimal corporate failure rates, etc.), the less flexible the aggregate system becomes and the greater the odds that it will become macro-unstable. The macro-unstable system cannot adjust to rapid changes in world markets -- with all the attendant problems of unemployment, low rates of job creation and general macro insecurity.

The choice between these two forms of stability is a very painful one, and we pay a price either way we go. To opt for micro instability to achieve aggregate adaptiveness means that no one's job is secure and no one's company is secure. Personal anxiety levels are much higher. On the other hand, the overall chances of having a job (given a willingness to be mobile and split up families) is much higher. As mentioned above, the places within the U.S. with the highest levels of churning (corporate and job turnover) have the healthiest overall economies and the lowest unemployment rates.

Opting for micro stability (job security, little pressure to move, low corporate turnover) provides much higher levels of immediate personal security. It leads, however, to "macro anxiety" -- the fear that no one will have a job if the system does not become more adaptive sooner or later.

Comparing the U.S. and the U.K. along this dimension, for example, we appear to have made a very different set of choices. The U.S. has opted for (or more accurately adopted) micro instability to an extent that, to many, appears (and is) terribly inhumane. As indicated above, we turnover 8 to 10 percent of our jobs and corporations each year. The greater the turnover, the healthier the local economies. No one's job is secure. Many today face long-term unemployment, and our expectation is that they must move and change careers to survive -- in most cases with little or no assistance and at their own expense. We are one of the most mobile nations in the world -- between 8 and 12 percent of our residents move from one area of the country to another each year to adjust to the micro instability found in any one area.

These are not just statistics. There is real suffering involved. Bluestone and Harrison, in their book, The Deindustrialization of America [1], describe in graphic detail the psychic and financial hardships caused by the rapid shifts of capital and companies and families in the American economy today.

On the other hand, this system has adapted. We have changed our export mix to maintain our balance of payments. We have created 19 million jobs in the past ten years to provide job opportunities for most people seeking them. We now employ a greater percentage of our adult population than ever before in history. In short, we appear to be remarkably macro stable.

Many EEC nations, in contrast, have positioned themselves on the opposite end of this scale. They offer great micro stability and security. Corporations and jobs do not come and go at nearly the same rate. People do not move at nearly the same rate. Individual income and housing and health care are much more likely to be guaranteed to those in need of them -- regardless of ability to pay. In sum, the system is far more humane from an individual perspective.

The price they pay, however, is less aggregate adaptiveness. Corporations and individuals, under less pressure to change, change less and the overall economy sags. As the U.S. was creating 19

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1. Barry Bluestone and Bennet Harrison, The Deindustrialization of America

million new jobs in the 1970's, from a base of 70 million, the EEC nations as a group created only one million from a base of 105 million, and the U.K. lost .3 million from a base of 23.5 million.

From our perspective, neither extreme is desirable, and any nation suffers -- each in its own way -- from being at an end point. It is clear that, if the U.S. does not find a way to ameliorate the hardships being caused by high churning and rapid transition, a backlash of substantial magnitude will develop to slow us down and disrupt the job-creation progress we have made. Conversely, if other nations do not introduce more churning into their systems (at the expense of some individual and corporate security) they will not transition rapidly enough and will be left with staggering unemployment problems, approaching 15% - 20% by as soon as 1990 by some calculations.

The challenge to each nation in the next few years will thus be a move toward, rather than away from a more central position. We must learn how to adopt the best that the others have to offer, without falling into the many traps that lie along the way. This does not mean that we adopt each others policies. Quite the contrary, it suggests that, coming at job-creation as we do from culturally very different perspectives, we must find within our own systems, the mechanisms to become both humane and expansive at the same time.

Mr. WALGREN. Dr. Lindsey.
[The biographical sketch of Dr. Lindsey follows:]

RESUME

QUENTIN W. LINDSEY,
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Background in analysis of the structural organization of societies, including the design of institutions and the formation of policies and programs essential to development and change. Experience includes (1) principal investigator for a number of research projects while with the Research Triangle Institute; (2) assisting the Government of Egypt in planning the use of Egyptian scientific resources in the development of Egypt (3) study of the Research Applied to National Needs program of the National Science Foundation; (4) numerous short assignments in Asia and Africa for the Ford Foundation, U.S. AID and the United Nations; (5) advisor to the Government of Nepal (six years); (6) advisor to the Government of Burma (one year); and (7) graduate teaching and research (eight years) relating to the economic, social, political and philosophic foundations of national policy.

Positions Held

August 15, 1977 to date. Science and Public Policy Advisor to the Governor of North Carolina, North Carolina State Government, 116 West Jones Street, Raleigh, North Carolina. 27611 Telephone: (919) 733-6500.

1969-1977 Research Triangle Institute, Research Triangle Park, North Carolina.

1968-1969 Visiting Professor, Carolina Population Center and Department of Economics, University of North Carolina.

1962-1968 Economic Advisor and Project Leader, His Majesty's Government of Nepal (Ford Foundation).

1961-1962 Economic Advisor (Ford Foundation), Union of Burma.

1955-1961 Associate Professor, Department of Economics, North Carolina State University, Raleigh, North Carolina.

1951-1954 Project Leader, Southeast Research Committee (An association of Economics Departments of southeastern universities.

Education

B.S., Economics, University of Nebraska, 1948
M.S., Economics, University of Nebraska, 1950
Ph.D., Economics, Harvard University, 1960

Dr. **Lindsey**. Mr. Chairman, members of the subcommittee, I welcome the opportunity to testify regarding overall perspectives and trends pertaining to technology and employment. My remarks consist of four propositions.

The first proposition: Technology and employment, as addressed by these hearings, must be concerned with two interrelated aspects of change in U.S. society; that is, the technical and the organizational.

One, examples of the technical change are the development of a better computer chip through microelectronics; the perfection of highly productive, disease-resistant plants through biotechnology; and the development of a sophisticated robot by engineers.

Two, examples of associated organizational aspects of change are the current introduction of robots in the manufacture of automobiles; the organization of many new "high-tech" firms that manufacture computers, robots, and other microelectronics-related products; and the innovative ways of dealing with agricultural surpluses such as the current "production in kind" procedure of the Department of Agriculture.

Thus, under this proposition, I assert that advances in technology entail transformation of our society. The roles of people in society change as this transformation takes place.

Some automobile workers lose their jobs. Those retained must learn how to operate robots instead of tightening bolts. Some people find new jobs as new firms are organized. Payment in kind reduces agricultural surpluses and results in fewer farmers being forced out of farming, at least for a year or more.

Employment, as I define it here, includes all the roles that people play in economic activity: Workers and their jobs, employers and their managerial functions, governmental people running an agricultural program, and so on.

In fact, we are fundamentally concerned, in this transformation process, with creating "meaningful places" for everyone in society, including meaningful lives for youth, for senior citizens and for the disabled, as well as for those in their most productive years.

It is not just a matter of finding jobs for workers. The focus of technology and employment should be upon the potential of technical and organizational innovation to provide meaningful places for all. I call this the technological potential of science.

Second proposition: To realize the technological potential of science, it is necessary that government, academic institutions, industry, and other forms of economic, social, and political organization concentrate upon utilizing the power of scientific advance to create meaningful places for everyone.

To symbolize this objective, I use the word "jobs." But I mean that everyone must have a meaningful job or role in society, a role that is on balance productive.

Within a lifetime, each of us must give to society more than we take away. But within that lifetime, the give and take will vary. As students, we receive so that we may be more productive in later occupations.

Within a working lifetime, many of us will change occupations several times and retraining will often be necessary. In later years, productivity will diminish, but retirement should not imply cutoff, exclusion or escape from productive roles; it should mean tapering off through organized means of continuing to perform useful functions.

If you accept my concept of jobs and a full employment society, then it is appropriate to differentiate between centralized versus decentralized decisionmaking, and we need both types.

A market, such as the housing market in the United States, is a form of decentralized decisionmaking. But the market functions within and is made possible by certain highly centralized decisions; for example, the constitutional provision for private property, decisions of the Federal Reserve Board regarding money supply and interest rates, et cetera.

Likewise, freedom of speech and freedom of religion result in highly decentralized decisions by people of the United States, but these also are dependent upon highly centralized constitutional provisions.

The point under this proposition is that the key to creating meaningful places or jobs for all people throughout society lies in the strategic decisions of key components of society. Some will be highly centralized, others decentralized, and all interrelated.

Moreover, these decisions must capture the imagination and involvement of people at all levels of society.

Perhaps I could illustrate this third proposition by reference to three significant components of society: One, government; two, education and research institutions; and, three, business and industry.

In North Carolina, we are placing great emphasis upon sweeping improvements in elementary and secondary education, including education in science and mathematics. The reason is simply that no one can function effectively in society today and in the future without completing rigorous education at these levels.

In our research and higher education institutions we are supporting research in basic fields of science, such as microelectronics and biotechnology, especially as they pertain to engineering, medicine, agriculture, and forestry.

Along with the research, we are striving to strengthen graduate, undergraduate, and technical training so that our people will become highly competent in a broad array of occupations, including shifting from one occupation to another within a lifetime.

The major job-creating thrust, however, is in our concern with technological innovation processes. Initially, we are taking steps to foster small business development through creation of local incubator facilities, provision of seed or start-up capital, development of venture capital sources, and linkage between these activities and our universities, colleges and technical institutes.

Later, we believe that forms of innovation must be directed also toward more imaginative creation of health services, and challenging opportunities for older people as they reach the conventional retirement age.

Fundamental to this illustration is the contention that jobs, that is meaningful roles for all people, are created and exist at local levels of society. Therefore, our strategy is not to impose a State-level plan for education and economic growth upon people at the local level.

Instead, it is to foster, through regional meetings with local leaders and through other means, the desire by local people to improve their schools, to establish new business firms and to otherwise create more meaningful roles for everyone.

The obligation of State government, and State-level firms and institutions operating within the State, becomes that of supporting and enhancing local institutions. It is also the function of State government to insure that consideration is given to ecological balance; for example, environmental quality, population growth and distribution, and so on.

My fourth and last proposition pertains to the Federal role in relation to what I have set forth as primarily State and local initiatives. Clearly, the Federal Government must maintain stable economic conditions, including controlling inflation; it must support basic research; it must foster appropriate regional activity involving two or more States, and so on.

But my last proposition today is that scientific enterprise in the United States must be shifted from primarily a military orientation to such technology and employment pursuits as I have outlined, pursuits in which the details of formulation and implementation are given over to State and local levels of decisionmaking.

As a nation, we created in the 1940's a formidable organization by which we mobilized our scientific and engineering resources for the purpose of winning World War II. That same organization, expanded and improved, dominates the role of Federal Government today.

More than half of the Federal R&D budget flows through the Department of Defense where the Government is also its own best customer for the products developed.

As a consequence, we have given relatively little attention to the process by which scientific advances can be harnessed for the purpose of creating jobs and associated civilian products and services, as I have suggested be done.

Japan, however, has excelled in this regard. And Japan spends little on military weaponry.

Now, the question is whether we can continue the growing military emphasis and also control inflation and create and maintain full-employment conditions through technological innovation, as I have suggested.

I personally think that we cannot and that no nation can do so. The two objectives are fundamentally inconsistent with one another. Therefore, I do not believe it is possible to mobilize the political support at Federal, State and local levels essential to have both guns and butter simultaneously, and at the same form and level of full employment that I have put forward as a goal.

If you will reflect upon the number of times you have sat on other committees and decided that the budget is insufficient to cover both military needs and creative domestic programs, you know what I mean.

Internationally speaking, the same logic holds. The nature and extent of world markets for what we can and should produce is dependent upon how we assist other nations develop economically and achieve forms of ecological balance between population and resources. Armament shipments are among the least productive ways to do it.

And, finally, it is my view that, globally speaking, civilization and the armament race represent a contradiction in terms. I suggest that those political leaders who recognize this, and who learn how to articulate its meaning domestically and internationally, will become the political leaders over the rest of this century. I would hope that you keep this proposition in mind as you consider overall perspectives and trends.

Mr. WALGREN. Thank you, Dr. Lindsey.

[The prepared statement of Dr. Lindsey follows:]

TECHNOLOGY & EMPLOYMENT IN THE U.S.: OVERALL PERSPECTIVES & TRENDS[1]

Mr. Chairman and members of the Subcommittee on Science, Research and Technology and the Task Force on Education and Employment: I welcome the opportunity to testify regarding "Overall Perspectives and Trends" pertaining to "technology and employment." My remarks consist of four propositions, with brief elaboration of each. I use the term "proposition," rather than "principle" or "premise," because I will present little empirical evidence in support of these points. Yet I believe they are relevant to the issues you are beginning to address.

First Proposition

Technology and employment, as addressed by these hearings, must be concerned with two interrelated aspects of change in U.S. society--i.e. the technical and the organizational.

1. Examples of the technical or physical aspects of change are the development of a better computer chip through microelectronics; the perfection of highly productive, disease-resistant plants through biotechnology; and the development of a sophisticated robot by engineers.

2. Examples of associated organizational aspects of change are the current introduction of robots in the manufacture of automobiles; the organization of many new "high-tech" firms that manufacture computers, robots and other microelectronics-related products; and the innovative ways of dealing with agricultural surpluses such as the current "production in kind" procedure of the Department of Agriculture.

Thus, under this proposition, I assert that advances in technology entail transformation of our society. The roles of people in society change as this transformation takes place. Some automobile workers lose their jobs. Those retained must learn how to operate robots instead of tightening bolts. Some people find new jobs as new firms are organized. Payment in kind reduces agricultural surpluses and results in fewer farmers being forced out of farming, at least for a year or more.

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[1] Testimony given by Quentin W. Lindsey, Science and Public Policy Advisor, Office of the Governor, North Carolina State Government, Raleigh, given before the Subcommittee on Science, Research and Technology of the Committee on Science and Technology, and the Task Force on Education and Employment of the House Budget Committee, Congress of the United States, Washington, June 7, 1983.

Employment, as I define it here, includes all the roles that people play in economic activity: workers and their jobs, employers and their managerial functions, governmental people running an agricultural program, and so on. In fact, we are fundamentally concerned, in this transformation process, with creating "meaningful places" for everyone in society, including meaningful lives for youth, for senior citizens and for the disabled, as well as for those in their most productive years. It is not just a matter of finding jobs for workers. The focus of technology and employment should be upon the potential of technical and organizational innovation to provide meaningful places for all. I call this the technological potential of science.

Second Proposition

To realize the technological potential of science, it is necessary that government, academic institutions, industry and other forms of economic, social and political organization concentrate upon utilizing the power of scientific advance to create meaningful places for everyone. To symbolize this objective, I use the word "jobs." But I mean that everyone must have a meaningful job or role in society, a role that is on balance productive.

Within a lifetime, each of us must give to society more than we take away. But within that lifetime, the give and take will vary. As students we receive so that we may be more productive in later occupations. Within a working lifetime, many of us will change occupations several times and retraining will often be necessary. In later years productivity will diminish, but retirement should not imply cutoff, exclusion or escape from productive roles; it should mean tapering off through organized means of continuing to perform useful functions.

Inherent in this proposition is the conviction that work or productive activity contributes to the meaning of life just as does recreation, study, contemplation and adventure. But for productive activity to be feasible for all, society must be so organized that there are meaningful jobs for all. Few individuals in today's world can create places for themselves acting alone.

Third Proposition

The conventional dichotomy between public and private functions--free enterprise versus big-government socialism, or capitalism versus communism--is too simplistic to provide meaningful policy guidance in this technology-employment arena. We need many forms of organization, even innovative forms we have not yet conceived, and technical advances make many forms possible. We may need also to rid society of some forms that have outgrown their usefulness.

If you accept my concept of jobs and a full employment society, then it is appropriate to differentiate between centralized versus decentralized decision-making--and we need both types. A market, such as the housing market in the U.S., is a form of decentralized decision-making. But the market functions within and is made possible by certain highly centralized decisions--e.g. the constitutional provision for private property, decisions of the Federal Reserve Board regarding money supply and interest rates, etc.

Likewise, freedom of speech and freedom of religion result in highly decentralized decisions by people of the U.S., but these also are dependent upon highly centralized constitutional provisions.

The point under this proposition is that the key to creating meaningful places or jobs for all people throughout society lies in the strategic decisions of key components of society. These decisions are both technical and organizational in nature. Some will be highly centralized, others decentralized, and all interrelated although not obviously so. Moreover, these decisions must capture the imagination and involvement of people at all levels of society.

I cannot in the few minutes available, set forth a comprehensive strategy of decision-making for technology and employment. But perhaps I could illustrate this third proposition by reference to three significant components of society: (1) government, (2) education and research institutions, and (3) business and industry. Within these components I will concentrate upon elementary and secondary education, research and higher education, and technological innovation processes.

In North Carolina we are placing great emphasis upon sweeping improvements in elementary and secondary education, including education in science and mathematics. The reason is simply that no one can function effectively in society today and in the future without completing rigorous education at these levels. In our research and higher education institutions we are supporting research in basic fields of science, such as microelectronics and biotechnology, especially as they pertain to engineering, medicine, agriculture and forestry. Along with the research, we are striving to strengthen graduate, undergraduate and technical training so that our people will become highly competent in a broad array of occupations, including shifting from one occupation to another within a lifetime.

The major job-creating thrust, however, is in our concern with technological innovation processes. Initially, we are taking steps to foster small business development through creation of local incubator facilities, provision of seed or start-up capital, development of venture capital sources, and linkage between these activities and our universities, colleges and technical institutes. Later, we believe that forms of innovation must be directed also toward more imaginative creation of health services, and challenging opportunities for older people as they reach the conventional retirement age.

Fundamental to this illustration is the contention that jobs--i.e. meaningful roles for all people--are created and exist at local levels of society. Even Congress and federal agencies are located within the District of Columbia and surrounding counties, and membership in Congress is dependent upon votes in precincts back home. Therefore, our strategy is not to impose a state-level plan for education and economic growth upon people at the local level. Instead, it is to foster, through regional meetings with local leaders and through other means, the desire by local people to improve their schools, to establish new business firms and to otherwise create more meaningful roles for everyone. The obligation of state government, and state-level firms and institutions operating within the state, becomes that of supporting and enhancing local initiatives. It is also the function of state government to ensure that consideration is given to ecological balance--e.g. environmental quality must be maintained and population growth and distribution are relevant.

Proposition Four

My fourth and last proposition pertains to the federal role in relation to what I have set forth as primarily state and local initiatives. Clearly, the federal government must maintain stable economic conditions by controlling inflation, it must support basic research, it must foster appropriate regional activity involving two or more states, and so on. But my last proposition today is that scientific enterprise in the U.S. must be shifted from primarily a military orientation to such technology and employment pursuits as I have outlined, pursuits in which the details of formulation and implementation are given over to state and local levels of decision-making.

As a nation, we created in the 1940s a formidable organization by which we mobilized our scientific and engineering resources for the purpose of winning World War II. That same organization, expanded and improved, dominates the role of federal government today: More than half of the federal R&D budget flows through the Department of Defense where the government is also its own best customer for the products developed. As a consequence, we have given relatively little attention to the process by which scientific advances can be harnessed for the purpose of creating jobs and associated civilian products and services, as I have suggested be done. Japan, however, has excelled in this regard. And Japan, please note, spends little on military weaponry. Now, the question we face is whether we can continue the growing military emphasis and also control inflation and create and maintain full employment conditions through technological innovation, as I have suggested. I personally think that we cannot and that no nation can do so. The two objectives are fundamentally inconsistent with one another. Therefore, I do not believe it is possible to mobilize the political support at federal, state and local levels essential to have both guns and butter simultaneously, and at the same form and level of full employment that I have put forward as a goal. If you will reflect upon the number of times you have sat on other committees and decided that the budget is insufficient to cover both military needs and creative domestic programs, you know what I mean.

Internationally speaking, the same logic holds. The nature and extent of world markets for what we can and should produce is dependent upon how we assist other nations develop economically and achieve forms of ecological balance between population and resources. Armament shipments are among the least productive ways to do it. And finally, it is my view that, globally speaking, civilization and the armament race (as we have now perfected it) represent a contradiction in terms. I suggest that those political leaders who recognize this, and who learn how to articulate its meaning domestically and internationally, will become the political leaders over the rest of this century. I would hope that you keep this proposition in mind as you consider overall perspectives and trends.

Mr. WALGREN. Dr. Chamot.

[The biographical sketch of Dr. Chamot follows:]

DENNIS CHAMOT
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PROFESSIONAL POSITIONS

- Assistant Director, Department for Professional Employees, AFL-CIO (1977 - present)
- Assistant to the Executive Secretary, Council of AFL-CIO Unions for Professional Employees, 1974 - 1977.
- Research Chemist, E. I. duPont de Nemours & Co., 1969 - 1973

CURRENT PROFESSIONAL ACTIVITIES

- Member, Labor Research Advisory Council, U.S. Department of Labor
- Advisory Board, Center for Policy Alternatives, Massachusetts Institute of Technology
- Advisory Panel, Information Technology, Automation and the Workplace, Office of Technology Assessment, U.S. Congress
- Committee on the Education and Utilization of the Engineer, National Research Council
- Councilor, American Chemical Society (1975-)

PAST PROFESSIONAL ACTIVITIES

- Committee on Computer Aided Manufacturing, Assembly of Engineering, National Research Council (1980-1981)
- External Review Committee member for National Institute for Occupational Safety and Health criteria documents
- National Science Foundation, Public Understanding of Science Advisory Committee (1977-1979)
- Secretary-Treasurer, Society for Occupational and Environmental Health (1978-1982)
- Chairman, Division of Professional Relations, American Chemical Society (1982)

EDUCATION

- BS, Polytechnic Institute of Brooklyn
- MS (Chemistry), Polytechnic Institute of Brooklyn
- Ph.D. (Chemistry), University of Illinois
- MBA, Wharton School, University of Pennsylvania

Dr. **Chamot**. Mr. Chairman, the disadvantage of speaking last is that many points have already been made. The advantage may be that I have the opportunity to tie it all together.

Labor's concerns about new workplace technologies are long standing. We have learned to deal with many forms of automation in the past and, overall, we and the Nation as a whole have prospered.

However, we believe that the current situation is sufficiently different from the past to warrant close scrutiny and a high level of concern.

Several of the speakers have already talked about the historical perspective. As with many countries, the United States began as a primarily agricultural nation. As recently as a century ago, fully one-half of our workforce was engaged in agriculture. As farming productivity increased, to a large measure as a result of technological advances, many farmers, and large numbers of immigrants, were forced to look for jobs in the cities and the growing factories.

Indeed, farming has become so productive that less than 3 percent of our workforce today are agricultural workers. There are only one-third the number of farm workers today as compared to a century ago, even though our population has expanded severalfold.

Manufacturing technology has also improved tremendously. We hear a lot about slow productivity growth rates compared to some of our international competitors; but, even so, today's factories are enormously more productive than those of the past. They need to employ far fewer people than would have been necessary if we never advanced beyond 19th century technology.

Just as rising farm productivity in the past sent many people to work in the manufacturing sector, so too has developing manufacturing technology in more recent times diminished job opportunities in our factories.

For the last few decades, much of the employment growth has been in the service sector, including government.

Today more than half of the American workforce are white collar employees. Even in manufacturing companies, almost a third of their employees are white collar.

Overall, we have seen a shift from agricultural work to manufacturing to service jobs. But today, in the midst of the worst recession since the Great Depression, companies and governments at all levels are under financial pressure. Everyone wants to improve productivity, and many are approaching the problem with the traditional view that higher productivity is achieved through the use of more machines and fewer people. But we have run out of sectors. Where are the displaced people, and new workforce entrants, going to go?

One can argue that today's technological advances will result in lower costs, business expansion, and ultimately, job growth. This appears to be the pattern in the past, at least on average. But we believe that the past is not a reliable guide to us today because of fundamental differences in the technologies themselves.

In the past, technological changes were introduced into workplaces in a slow, piecemeal fashion. To a great extent, the changes were quantitative, making a particular kind of machine more productive, or permitting an individual operator to run more than one machine simultaneously. The job itself, though, usually was not drastically changed in its essential features.

Computers and microchips offer the possibility for massive, qualitative changes. It is now possible to seriously think of factories without people. The enormous capacity and speed of computers and microchips allow machines to be given flexibility and some decisionmaking capability, characteristics formerly within the exclusive province of human beings.

Indeed, the often unspoken goal of CIM, or computer integrated manufacturing, is to have computers control all aspects of manufacturing. We can leave the people out, by design.

Now, this somewhat apocalyptic scene will not occur any time soon. Human workers will be required in factories for a long time to come. However, I think it is safe to say that the trend is in the direction of increasing automation, and that as real economic growth resumes sometime in the future, the increased output will be produced with far less rehiring than was the case in the past.

What makes potential problems even worse is the fact that it is not only manufacturing facilities which are increasing their use of computers and programable equipment. Precisely the same trend is occurring in services and office work in general.

It is interesting to note that developments in office automation are in many ways following the manufacturing pattern.

At first, improvements are made in individual machines or jobs. For example, stand-alone word processors replace typewriters, and individual productivity rises. Or computerized microfiche systems replace steel filing cabinets.

In essence, the capacity is increased, but the job is recognizable. But just as there is discussion of peopleless factories, so too is there work toward the paperless office.

While it is not explicit, the latter term implies fewer people too. Again, the key is the extensive use of computers, microchips, and sophisticated electronic communications.

Several firms are already offering systems which allow an individual to create documents, from small memos to major reports, including tables and charts, to file or retrieve documents, to tap into large data banks, to send messages to other people hooked into the system, to receive computer generated reports, to do a hundred and one things by himself or herself, without the assistance of secretaries or file clerks or even middle level managers.

In general, the service sector of our economy has been relatively labor intensive. Automation is occurring here also. Banks have automatic machines for check processing; computer terminals for their tellers, eliminating a lot of internal clerical work; and automatic teller machines.

I have heard that the fast food industry in Japan is considering the use of robots, and it wouldn't surprise me to see that kind of technology adopted here.

The telephone system is converting to electronic switching, eliminating both telephone operators and maintenance jobs.

Even the U.S. Department of Labor uses an automatic cart for internal delivery of mail.

It can be argued that all of this new technology creates a lot of jobs in the manufacture, installation, maintenance and use of the new equipment. This is true, but the displacement is much greater.

It is a question of relative rates. If productivity increases faster than the growth in overall output, employment will drop.

I understand that auto industry calculations indicate a net displacement of two to four jobs for each robot installed.

In the banking industry, I have heard estimates as high as 30 percent for the net job loss during the decade of the 1980's, even with great economic growth for that industry.

I could go on with other examples, but the key points are modern technologies have incredibly large capacities, and applications are being found throughout our economy, in every kind of organization, at every level.

We are faced with nothing less than the redefinition of work and, in the process, a lot of positions will be eliminated.

All of this leaves us with several very major issues. In the first place, we may be entering a period of permanent labor surplus. As the economy improves, the unemployment rate may not drop to levels as low as they have in the past; fewer people will be needed to produce the higher levels of output.

Second, no matter what happens to overall unemployment rates, it is clear that there will be a great need for training, for retraining, and for adult education. Who will provide this? Who will pay for it?

Third, technological developments sometimes tend to take on a life of their own, yet engineering designs are not handed down from heaven. They reflect the parameters and constraints within which the designers work.

The results may not always be those that are most desirable from a social policy standpoint. How can exogenous factors be made a part of the system?

Related to this is the whole issue of the devastating effects of plant closings on both the affected work force and the communities in which the closings occur. We need to find ways to encourage businesses to update existing plants as much as possible, or to use them in new ways, before considering creation from scratch of modern plants in other locations.

Fifth, related to all of the above, where will future jobs come from? We not only need new industries to replace factories that have been closed, but also additional jobs for people no longer needed by ongoing enterprises which have automated, as well as to meet job demand created by population growth.

Perhaps we need to think about spreading the available work around. We have had the 8-hour day, 5 day work week for decades. We still traditionally have 2-week vacations, although many union contracts call for more.

Instead of raising the social security retirement age, shouldn't we be looking for ways to lower it?

Perhaps some of the productivity gains generated by new technologies should be used to reduce work time without financial penalties for the individuals involved.

Many unions have been trying to deal with problems resulting from the introduction of work place technologies for some time, including such nontraditional areas as job stress caused by computer pacing.

There is certainly a continuing role for collective bargaining in this area, but many of the issues that have been discussed today, and will be discussed throughout these hearings, demand active participation by Government as well.

There is a great need for training and retraining programs, for protections of salaries and benefits as people are shifted into new positions, for real improvements in the quality of working life rather than having the machines dominate the work environment.

To a very great extent we need joint action on the part of all affected parties—government, labor, business, and the community.

American unions accept the need for improving productivity. We are not opposed to new workplace technologies provided the new equipment is used for the betterment of all and not just for the gains of a few.

Our society could not long exist with ever-widening gaps between those who benefit from new technology and those who are cast aside. Proponents of computers and robots like to paint a rosy picture of the better life possible through the application of these remarkable technical achievements. It will not come automatically.

The potential benefits are very great. So are the problems.

I commend you, Mr. Chairman, and the other members of these committees, for your efforts in attempting to review these issues in all their broad complexity.

I have brought with me and will offer you for inclusion in the record three of our recent publications dealing with many of these issues.

[The information follows:]

Technological Change and Unions

An International Perspective

INTRODUCTION

The problems brought about by the introduction of technological changes at workplaces are truly international in scope. While there is a great tendency to view situations narrowly, looking only at what is happening right now, right here, at how it affects me directly, such an approach is sure to fail, at least in the long run.

Modern technologies know no national borders. Both design and production can be shifted from one country to another. Services, like data processing can be transferred electronically even more easily. And equipment which is developed in one country for use in a particular industry is often quickly adapted for use in other industries and other countries.

Our trade union colleagues around the world are faced with many of the same problems we are facing. Legal systems and customs vary but there is still much that is common ground and we have a great deal to learn from one another.*

It was in this spirit that the DPE's Committee on Scientific, Technical and Engineering Personnel, chaired by Rodney A. Bower, presented the conference Technological Change and Unions, An International Perspective,** in New York City in November, 1981. The conference was attended by delegates to the 3rd Biennial Convention of the AFL-CIO Department for Professional Employees and visitors from other AFL-CIO Departments and unions, government, and academia. Most important, however, it gave American and European trade unionists an opportunity to engage in a far reaching and in depth exchange of experiences and views.

The texts of five major presentations to the conference follow.

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* See, for example, the full discussion in "Cooperation or Conflict. European Experiences with Technological Change at the Workplace." This publication is available from the Department for Professional Employees, AFL-CIO.

** Funds for this conference were provided in part by the German Marshall Fund of the United States.

TECHNOLOGICAL CHANGE AROUND THE WORLD

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The question of technology and the introduction of new technology into the workplace is not really one for which experts have the answers. This reminds me of something that happened a short time ago in Boston.

Two people went up in a balloon, and all of a sudden the weather changed and there were a lot of clouds. They could not see where they were. They did not know if they were drifting out over the Atlantic, if they were in Connecticut, or somewhere in Massachusetts, and they got quite concerned.

After about two hours of this, all of a sudden the clouds parted and there was a person standing below on the ground. One of the people in the balloon yelled down, "Where are we?" and the person on the ground looked up at the balloon, looked around, looked back up at the balloon, and then he yelled, "You're in a balloon."

The two people in the balloon looked at each other and one of them looked back down and said, "Are you an economist?" The person on the ground yelled up, "Yes," and his friend said, "How did you know he was an economist?" The person who originally yelled said, "It was easy. I don't know anyone else who could give you an answer that quickly, that is so logical, that tells you so little about where you are or where you want to go."

Unfortunately, too much of the analysis of new technology has had this static quality to it. When we talk about new technology today, we are not talking about machines and systems, but we are really talking about jobs, about working conditions, and about the economic health of the community.

Today we are seeing an unprecedented infusion of new technology into industry, a technology that is largely based on computers and microelectronics, and it is, of course, a technology that has enormous promise. There is the promise of new industries which will create new jobs. There is the promise of more creative work. There is the promise of a more productive society where people share in an ever-increasing product.

Unfortunately, while the promise of this technology is indeed great, we are seeing it develop and deployed in a far different direction, and it is a direction that I think should cause very legitimate and widespread concern.

Before getting into the implications of these technological changes, I would like to dwell for a moment on why automation today is being fundamentally redefined, why we are really dealing with something that is different from the automation we have known in the past.

Computers, of course, are not a new technology any more, but what we are witnessing today is microelectronics, bringing the power of computers right to the point of production, whether that is a word processor in the office or a robot on the assembly line. This form of automation is really fundamentally different from previous forms in two ways: first, its scope, and second, its rate of change. Let's look at its scope for a moment.

The term "automation" was first used in the late 1940's and early 1950's to describe automatic transfer machines in the automobile industry, the movement of machine parts from one machine to the next without human interference. But it was a technology that was very rigid. Great economies of scale were achieved but only at the price of real inflexibility. A small change in the part meant a massive change in the tooling. So automation was limited to one part of mass production industry.

Today computer-based automation is characterized by its flexibility. Rather than change the machine, the instructions to the machine are changed. As a result, we are talking about something far different than a new form of machine or even a new system. We are talking about the computerization of the workplace.

Every activity from design to production is affected by computer-based automation, robots on the assembly line, computer aided design in the engineering office, numerical control in the machine shop, the word processor in the office -- all of these are in fact governed by the same technology, the information processing capability of computers, and the ability of microelectronics to get that power right to the point where work is done. In any given workplace these are no longer separate systems. They are very much linked together in a highly integrated whole.

In manufacturing, for example, an engineer sitting in a design office can communicate directly to a machine tool in the factory. In the office the term is networking, and it means that word processors, printers, disc files, the whole range of automated equipment, are linked together, sharing information, talking to each other.

The scope of this technology is far broader than anything we have seen in the past. It affects every productive sector of the economy. But the rate of change is so fundamentally different both in the development of technology, and the rate of introduction in the workplace. In the 1950's the automated equipment that was introduced in the auto industry was still more or less state of the art by the 1960's. There were important refinements but no fundamental changes. Today we are looking at changes not only in terms of years but in terms of months, and at times even of weeks.

For each of the past two years the number of functions of a computer chip has doubled while the price of a chip has been cut in half, and this fact alone has led to the rapid rate at which this technology is being introduced into the office and into industry.

Let us first look at the office. One major management consulting firm looks towards a market for automated office equipment of $16 billion by 1990, up from $5 billion in 1978. Teleconferencing will grow at 21 percent a year, electronic mail at 19 percent a year.

In the engineering profession, computer aided design is already growing at a rate of about 35 percent a year. By 1985 it will be a market of $2.5 billion, up from $610 million in 1979.

Looking at manufacturing, the internal documents of one corporation say that of $900 million of assembly done a year, two-thirds can be automated by 1990, and one-third could be automated with existing equipment.

If we look at the automobile industry, just the Fisher Body Division of General Motors has enough in-house computer power for one and a half moon shots. In 1977 GM said that in the next five years it would increase its use of computers on the factory floor by 400 percent. That seemed like a remarkable figure, a 400 percent increase, in five years. But by 1981 GM had already increased its use of computers on the factory floor by 500 percent over 1977. While in the past the real danger in analyzing automation was often overestimating trends, today just the opposite may in fact be true.

The changes are certainly coming very rapidly, but what do they mean? I think there are three broad areas of concern to the labor movement and to the entire society: first, the question of jobs; second, working conditions; and third, the internationalization of production.

While many of the things developing today really are quite grim for workers and for unions, it is important to bear in mind that that is only one path of development. In fact there are very real alternatives. Technology is not something that is fixed. It is not some island waiting to be discovered in the future. It is a product of human decisions. And this technology in particular is very flexible and gives range to a great deal of alternatives. The real qustion is, how will it be affecting people, and whether workers will be the victims or the beneficiaries of change.

Let us first look at the question of jobs. Obviously, in any complex economy jobs are dependent on more than technology alone. There is the state of the economy, demographics, the state of a given firm, a wide range of factors that go into the whole question of employment.

However, today we are looking at a very rapid and pervasive introduction of a very powerful form of labor-saving technology against a background of a stagnant economy, and that could cause some real problems. We are seeing a simultaneous introduction of highly automated equipment in the white collar sector and in the blue collar sector. It potentially creates a kind of economic vice where workers are pushed out of the factory but no longer have the traditional areas of opportunity in the service sector and in the white collar sector, because these areas are also being affected by automation.

Let us consider for a moment the white collar sector and the employment implications of the technology. The report by a conservative officer of the Finance Ministry in France, Simon Nora, in 1978, predicted that by 1990, for a given volume of work, there would be a requirement of 30 percent fewer workers in the French insurance and banking industries.

The Siemens Corporation found similar results in an unpublished study which predicted that by 1990, 40 percent of the work in the office could be standardized and 25 percent automated. In the public sector the figures were even more startling, 75 percent of the jobs standardized, 38 percent automated.

What is also unique about this technology is that even the most highly skilled jobs can be automated. In engineering, computer aided design is roughly three to four times more productive than conventional design equipment. In some cases the results are even more spectacular. On a 1982 Dodge, for example, the geometry for the steering gear took fifteen minutes to design, whereas on a 1956 Dodge it took three months. According to the Society of Manufacturing Engineers, by 1987, for a given volume of work, there would be a requirement of 25 percent fewer parts programmers and tool designers.

Let us now look at the blue collar sector, because here the impact of automation is also dramatically increasing. For a $60,000 robot it costs General Motors $6 an hour on a two-shift basis for an eight-year period. For an auto worker it costs GM $20 an hour. This corporation alone plans to purchase 20,000 robots in the next ten years. There are fewer than a thousand robots by point of comparison in the entire United States auto industry today.

According to GM, the net loss in an auto assembly plant for each robot is 1.7 jobs. In a manufacturing plant it is 2.7 workers that are displaced for each robot after you factor in all the workers it takes to install the robot and service it. That means we could be talking about the loss of 40,000 to 60,000 jobs from one technology alone. And if anything, the robots that are introduced in the latter part of the decade will be far more productive than those that are introduced today.

Even if the economy performs well overall, even if it succeeds in generating enough jobs for the number of people who want and need to work, there is still a very serious problem of regional dislocation, and we don't have to look to the future for that. All we have to do is look at Detroit and at Boston today. In Boston, Massachusetts, there is a shortage of computer programmers. That does very little good to the hundreds of thousands of unemployed auto workers in Detroit, and we see no mechanisms to deal with what very likely will become an increasingly serious situation.

Employment has been a traditional concern in dealing with automation, but the second point I would like to address is working conditions. How will the technology affect the quality of working life? The technology really provides a choice: increased autonomy for the worker or increased authority in the workplace. It provides a choice of more skills or fewer skills, of more creative work or more tightly controlled work. In order to understand the impact of technology on the workplace, we have to go beyond the machines and systems that are being introduced, because microelectronics and computers will make possible anything they are asked to do. What we really have to ask is, what are the goals that these technologies are being designed to serve?

Recently the largest study of metal working ever undertaken was completed, funded by the United States Air Force. It included literally hundreds of representatives from machine tool companies, from machine tool users, from universities, from consulting firms, everyone but the workers who operate machine tools and the unions that represent them.

Let me read one of the central conclusions for automation in the coming decade. "Reduce the skill levels required to operate or maintain certain machine tools or to plan the manufacture of a part, an approach already practiced by some of the technically more advanced companies. This can be done by using more automation and substituting computers for people in executing certain decisions or operations."

In other words, the technology is being designed to remove skills, so it should come as no surprise if fewer skills are required.

In those areas where skills are not directly affected we see new technology used to monitor and control workers on the job, an electronic assembly line. For example, when the factory machine tools are linked to a central computer, if the machine goes down for over two minutes, a light goes on in the foreman's office and a hard computer copy is printed that the machine was down for a unauthorized amount of time.

In the supermarket when a can of soup passes by the new scanner, it can record more than the price of the soup. It can record the number of soup cans processed per hour and the number of errors the clerk makes, and compare this on different shifts or between different supermarkets.

In the office the word processor can do more than edit typed copy rapidly. It can record the number of key strokes per hour that a secretary makes, and in fact management looks toward that monitoring ability as one of the central benefits of the technology.

Let me read to you from a record by the Stanford Research Institute, Business Intelligence Unit. "Management has also found that with word processing it can for the first time monitor the productivity of secretarial workers and thus gain some degree of control over this clerical function."

Technology does make possible a better workplace, but it is nothing less than shocking to find out the results of a recent study by the National Institute of Occupational Safety and Health. In a 1979-1980 study of five firms in San Francisco, NIOSH concluded that there were higher levels of stress among operators of visual display terminals in strictly clerical jobs than in any other occupational group that NIOSH has ever studied, including air traffic controllers. Ironically, while most of this is rationalized in the name of productivity, very often productivity actually drops as a result of the use of technology in this way.

The new technology of today does more than automate a single factory or office. It lays the basis for a highly automated system of managerial decision-making worldwide through telecommunications. Management throughout the world is linked ever more tightly together.

Let me give an example of this. Ford has just come out with a new world car, a car that is marketed and manufactured throughout the world, the Ford Escort. This was designed using a new central computer facility in Dearborn, Michigan, near Detroit. During the day 5,000 Ford engineers and technicians from throughout the United States plugged into those central computers in Dearborn at the same time, using the same body of information. When it was night in Dearborn, Ford engineers in Germany, in Spain, in Great Britain and in France plugged into the same telecommunications system. Decisions were made in Dearborn about the overall parameters of the Escort, German engineers designed the engine, United States engineers designed the transmission, and literally worked in parallel at the same time.

This has other consequences than strictly the efficiency of design. It links management in the world together in real time as things happen while new boundaries are, in effect, erected between workers, because auto companies have a policy of dual sourcing for the parts that are made from these designs. That means more than one factory throughout the world producing the same parts.

With the Escort, a Ford plant in Dearborn, a Ford plant in Mexico, and a Ford plant in the United Kingdom will produce the same engine. A strike in any one of these plants can be more than compensated for by raising production in the two remaining plants. The plants are not designed to foil strikes. They are designed with surge capacity to respond to problems in the market. But it is that surge capacity that gives the corporation increased leverage when it comes to dealing with unions throughout the world.

The decentralization of production as a result of this is truly awesome. In the auto industry, which is not a case apart but really a concentrated form of what is happening throughout manufacturing, a recent University of Michigan study predicts that by 1985, 25 percent of all the parts of U.S. assembled cars will be produced in other areas of the world. By 1990, 35 percent. By 1985 Mexico will have the capacity to produce 2 million engines a year, 80 percent of which will be for export.

The issue is not the very legitimate right and pressing need of Mexican workers for jobs or the Mexican economy to develop an industrial infrastructure, but for the way the technology can be used to manipulate workers in one country against workers in another country.

There is a frightening new concept, technological scabbing, the ability to use new technology in a way that undermines the leverage of a strike. In 1979 when Blue Cross-Blue Shield workers went on strike in San Francisco, Blue Cross transferred almost 500 jobs to remote terminals to keep production operating during the strike.

But we don't have to go back to 1979. All we have to do is look at the recent PATCO strike. PATCO was considerably weakened not only because the Reagan administration has a hard-line posture on strikes in the public sector, but also because it spent over a year developing a very complex computer program called flow control to operate that system with a fill-in staff.

Finally, there is the question of competition. All of what I have said may be true, but the argument comes up, if United States industry does not adopt new technology, its foreign competitors will, and therefore undermine it in the marketplace. The argument is certainly true as far as it goes, but it neglects the fundamental problem that U.S. industry has had in the decade past which has not been the technology but which has in fact been U.S. management: accountants running production systems in manufacturing, shortsighted marketing decisions, and a range of other problems that technology will not correct.

What are the choices? Is the choice new technology, or no technology? Robots or no robots? I would contend that the real choice is not new technology or no technology but the development of technology with social responsibility, the development of technology in such a way that workers, the community, and the entire society benefits.

This must be more than a platitude, of course. It means linking the development of technology with real gains for workers and the community, so that the precondition of new technology becomes addressing the social problems that it creates, not something that happens after the fact, not retraining but pretraining.

In this way the promise of technology can truly be realized. The real goal ought to be the development and the use of a technology that serves people, the design of machines that serve people rather than people having to serve machines.

THE BRITISH PERSPECTIVE

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The microelectronics revolution is both an opportunity and a challenge. It is an opportunity because it can liberate us from excessive hours and unpleasant work, and it can cheapen many products in real terms. I think it is a challenge because without a planned direction, it will clearly have a lot of negative consequences in terms of job-killing skills, undermining union power, and increasing management control. But I am not so pessimistic to think that we cannot do anything about that.

The history of technological advance should teach us that there is always this two-sided aspect to it. Looking back over 150 years, I think we have got to recognize that it is the technological revolution that has created today's high living standards. In the 1930's people said full employment will never again be possible, and yet come the war everybody was able to get a job who wanted a job, and that included disabled people, women workers, and others. In some respects I think we are now again in a 1930 situation, because we have got combined with technological progress a shortage of effective demand in the world. I think that we must not approach the problem as if a return to full employment was impossible.

The environment of the 1980's is, of course, quite different from the environment of the 1960's. We have 3 million unemployed in Britain on the official figures, that is over 10 percent. By the TUC's calculations if you include people who are discouraged workers, and people who are also on government training schemes, you clearly have a lot more than 3 million, we would say about 4 million people out of work. So we are in the same league as you are in the United States.

I think it is important that we don't too readily define that as technological unemployment. Our unemployment in Britain over the last two years has gone up a lot more than the European average. It has doubled in the last couple of years. The European figure has gone up less than 50 percent. There must be something that explains that extra increase of unemployment in Britain. It is not just technology, and I would say it is something like Reaganomics, which I think we have probably exported to you.

But to return to the theme of technology, I think we have got to recognize that technology against this particular background can present an apparently insoluble and intractable problem for the trade union movement. We have tried to address it in a constructive way. We had a major report in 1969, and I don't think anyone would say that the TUC's attitude is a Luddite attitude. We have recognized the reality of international competitiveness, the risks from failure to change, the greater risks to factory employment from failing to change than from actually getting on and making the change.

At the level of collective bargaining, what we have said is that there should be technology agreements. These should include the following ten points:

No. 1, technology should be introduced on the basis of agreement.

No. 2, is the importance of establishing joint union machinery, bringing together white and blue collar workers. We believe that the single status approach in industry, and breaking down divisions between unions, is important. I am saying that as a principle, although our ability to deliver it in practice is not 100 percent.

No. 3, there must be advance information to the unions on the planning of new change before decisions are taken.

No. 4, security of employment. Ideally, of course, one wants no redundancy agreements but one wants to look at all possibilities of using natural attrition, redeployment of existing workforce, relocation and redundancy arrangements.

No. 5, to include in the agreements provision for retraining of all employees affected by the new technology in the skills required.

No. 6, hours of work. We say, crudely speaking, that when technology is on the agenda, hours of work must also be on the agenda.

No. 7, pay and conditions. There should be no loss of income as a result of the change. Rewards for extra skills required and also the possible need to redesign existing schemes should be taken into account.

No. 8, control of work. Trade unions must be involved in the design stage of a technological system, making sure that the provision of management to measure work performance is not built directly into programs. It is important that we should be sufficiently technically equipped to say what could go in the chip and what cannot go in the chip, and not be bamboozled into thinking that there is a technological imperative as to what the system actually involves.

No. 9, health and safety. We have got the right to have 50-50 control of health and safety in Britain through joint safety committees. We are saying that these should make provision for regular breaks in the work cycle and things of that nature.

And No. 10, last but not least, reviewing progress. We call for the establishment of joint union-management schemes to monitor progress following agreement on introduction through implementation and beyond with problems arising being processed through disputes procedures.

So those are the points we put forward. Now, any fool can write down a program. What are the chances of actually implementing it?

I think that, against the uniquely adverse economic environment, it is possible to say that we have made some progress. We have now recorded and monitored 100 technology agreements, mainly in the white collar area. Employers know that where unions are strongly organized they can only make progress on the basis of democratic involvement, protection of employment, and sharing in the benefits.

Against the background of British industrial relations, the ideal approach would be to have an agreement between the TUC and the Confederation of British Industries, not an approach I think which would be so relevant in the United States, and we did attempt this. We did indeed write a joint memorandum with the CBI, which the TUC ratified and the CBI, that is the employers' organization, failed to ratify.

One has the question, how much progress can one make through collective bargaining either at the firm or industry level or at the national level, and, on the other hand, how much should one demand statutory provisions in this particular field?

There is a contradition before us today of a need for rapid change, a need for a new role for the trade union movement in advanced industrial societies based on high technology, but a regression of the institutions which are able to deal with it. You see that in European countries generally. There is side by side with a commitment to making progress the same fear and disquiet that has been referred to by others. Involvement of the workforce has never been more necessary, but you might say that the political climate to achieve it has never been more discouraging.

I am reminded in looking at the overwhelming evidence of the challenges facing us of the situation in the American Civil War when the commander told his men to gather round as winter was approaching. He said, "Men, I have got some good news and some bad news. Which would you like to hear first?" They said they would like to hear the bad news first. He said, "Well, men, winter is approaching and we have run out of food and there is nothing to eat but buffalo dung."

They said, "God preserve us, but what is the good news?"

He said, "There's plenty of it!"

That would appear to be the situation that we are in at the moment. I think therefore, that we have got to operate at a number of different levels to get out of the situation. One of them is the level of political education. I don't mean in the technical sense, but in terms of objectives and strategy. You must ask yourself the question, what is the role of the legislators, what is the role of statutory protection in these particular areas? Is the whole of this part of a social contract in its broadest sense? In many respects, of course, this challenge makes that even more necessary.

There is a classic set of conditions before us for demonstrating that people need trade unions more than ever before, but what can unions actually do now to advance and protect the interests of the workers? How are we to view the employment prospect? And should we say that the answer is trade union action or action by the state?

Undoubtedly there has to be a combination of both, and that there is a major importance for the state in planning our social and economic development. Words in this context can easily be misunderstood. When you say planning, in the British context, and I am sure at least it is true in the American context, people assume you mean global planning. This concept that planning is a complete disaster because it fails to take account of market conditions is, of course, a politically popular viewpoint in both our countries. But I would ask the question the other way round, can we afford not to have a manpower plan for our nations over the next five or ten years? Can we afford to fail to meet the challenge of ordinary workers and their families that unless they have confidence in the future, they will not have confidence in the society?

None of this is incompatible with a competitive market environment. The irony about Japan is that they are the world's super competitors, and competition and markets go together. They certainly penetrate world markets, but in fact they plan. They plan their share of international trade, they plan in terms of the labor market, they plan in terms of the involvement of the unions, even though you might say that the role of the unions in Japan is not in line with the industrial tradition of either Britain or the United States. But they do have a certain consensus in their society about the role of technology, about the nature of change. While we might have different priorities for Japan than the Japanese about social provisions, housing, and all the rest of it, I think we have to recognize that they have a model of society which does combine the latest technology with a very low level of unemployment.

Unions in this connection have to put forward a positive program because it is no good being on the defensive. Thatcherism, monetarism, Reaganomics have all made unions into a political football, and yet we want to try and be constructive.

You may say, why should we argue about technology and employment when the governments of our two countries actually want a pool of unemployment? Some people might say that it is political rhetoric to say that a pool of unemployment is actually desirable, part of the economic policies of our two governments, but there are sufficient managerial statements on our side of the Atlantic to suppose that there is something in this, and so we have got to explain to our members that technology should not be confused with the political program of any one government. We have to transcend that argument by putting forward a program which will convince our own members and convince our citizens as a whole through the electoral process that we have a grasp of what the future needs in a way that other people do not have, and that must be the way in which we go forward.

There are many, many contradictions which will baffle the average trade union member. We have got to be clear how we resolve these contradictions. We have got to say what is the role of shorter working hours or early retirement or sabbaticals or holidays. We have got at the same time to state that, "Stop the world, I want to get off", is not our policy. I don't think there is any mileage in saying that we can solve our social problems, problems of the inner cities, problems facing us all in the sphere of youth unemployment by a zero growth in the gross domestic product.

We have put an immense effort into our educational programs which I hope will produce some substantial results as time goes by, and we are making a particular effort following from some of your experiences, in particular dealing with youth unemployment.

We now have a campaign which I am directly involved in called the "Jobs for Youth Campaign," and we have the Afro-Caribbean Association, the Association of Asian Youth, the Students Youth Aid, the British Youth Council, working with the TUC, because the greatest danger of all in this period is that we can be part of a divided society with black against white, women against men, old against young, skilled against unskilled, and that we must avoid above all.

We are calling for a reinforcement of measures towards a national manpower plan, a planning approach towards our resources, because when we put our minds to it, if you can plan to get to the moon, you should be able to plan what we do on this planet.

GERMAN DEVELOPMENTS

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My union, the Industrial Union of Metal Workers, has for more than twenty-five years worked on policies to meet the challenge of technological change. We have had to get our membership knowledgeable in this field. We have had three conferences, one on white collar workers and automation, the second on blue collar workers and automation, and finally one on technology agreements. We felt that the only way to handle this challenge is in a combination of the collective bargaining agreement on one hand, and on the other the necessary legislation which is helping us to install the best kind of policy to meet this challenge.

For more than thirty years we in Germany have had a split system of unions and the so-called works council system. Further, we have a system of co-determination which is a system of interplay between the works councils and those worker representatives who are elected to the supervisory boards of the different companies to secure what we call economic democracy.

In my country, industrial relations are determined by strong independent unions unified in one federation, the DGB, on the one hand, and effective management associations on the other hand. In the framework of social and labor legislation, autonomous collective bargaining is the battleground for both parties on the industrial level. On the plant and company level, legislation requires works councils or workers' representatives to represent all employees.

Besides collective contracts, co-determination rights are the typical German answer to the question of industrial democracy. This is the framework in which the unions in my country operate. In Germany we have only seventeen unions. This is very good, because there is no jurisdictional struggle between unions; there is the principle of one union, one plant, one collective agreement.

On the other hand, with the works council system, which is formally independent of the unions, the union is called upon to organize labor (we have no compulsory organization or closed shop) and to organize the works council as far as possible. That means that in practice we have 85 to 90 percent organized labor in the works council and we can operate with them within the framework of the collective bargaining contracts.

Both works councils on the one hand and representatives of labor on the company supervisory board on the other hand are acting to meet the challenge of automation and technological change. Just to use an expression, the representatives on the supervisory board are the early warning system, and those who are works councilors on the plant and company level are the task force to sit down with the company and negotiate as far as technological changes are concerned. The unions support them by education, seminars, and consulting work, doing consulting all over the industry.

Technological change and automation in Western Germany cannot be separated from the attempts to streamline production and lower the cost of industrial work. So we are not only looking at the machinery, we are looking at the whole scenery of work.

The technological changes cannot be separated from the market and from the labor market. They cannot be separated from the process to concentrate industrial power, because of the fact that usually only big companies are able to install these huge mechanical and automated changes. And it cannot be separated from the ability of the union and of labor to exert power by single unions or labor groups. Those might be some of the parameters to evaluate the nature and impact of automation and technological change.

To make it more concrete, I would like to give a number of examples which demonstrate how we had to react as the industrial union of metal workers and what we could install to prevent damage and to prevent a deep impact unfavorable to labor.

Let me go back to the automobile industry of the Sixties, which was expanding. Volkswagen exported more than 50 percent of its production, and as everybody will recall, the old design which was the model of Volkswagen for ages competed with comparable models on the European market. Volkswagen was the most highly mechanized factory we had in the automobile industry in Germany. When we got visitors coming in from the States or from Britain, we were always asked, how do you cope with this highly mechanized and automated plant? Don't you have any problems with layoffs?

But because the market was expanding, because sales were expanding, those who were normally put on layoff were rehired or transferred to new working places. That means training and retraining was one of the major tasks at that time, transfer of personnel but no layoff.

The basis of our difficulties during that time with the automobile industry was the complete breakdown of the classification system in the collective contract. Just as it is in other countries, in my country the classification is based upon three major groups -- skilled, semi-skilled and unskilled -- and subdivided into six, eight or ten subgroups. Because of the impact of mechanization and of the impact of highly mechanized and automated processes, the whole demand on skill, on craft, was eroded, and by using the normal agreement theoretically management could declassify hundreds or thousands of workers.

Combined with this was the danger of speedup. So we had to slot into our agreements a special protective clause against speedup, and we also had to slot in special protective clauses for rotation and to give an opportunity for personnel to be trained in more highly sophisticated crafts which, for instance, would be found in the field of electronics, or maintenance, and so on, and that was brought about. But at that time we had no real problems as we have at the present time in a shrinking economy.

I would like to mention watch manufacturing in the Black Forest, where an industry of about 50,000 went bankrupt in about three years because of the impact of microprocessors on the types of watches and on the manufacturing processes. However, with the help of the state and of local government officials to attract new firms to move in to the region, and set up there a new type of industry, the electronic industry, the greatest part of the redundant labor force was rehired, retrained, and put back on the job.

In other words, a labor market policy was developed. The necessary training, retraining, and rehiring was done in a combined program between the union, the works councils, and the municipal and state governments which gave tax incentives to bring new industry into a highly industrialized area at lower cost than would normally be the case.

Another example I would mention is the steel industry. This industry was facing automation for more than fifteen years, and modified processing and steel-making and rolling was already felt in the early Sixties. Because of technological change in various areas of steel making, the steel industry in our country had a loss of about 10,000 employees per year. Only by the installment of so-called social plans or plant agreements did we have the opportunity to cope with that for more than ten years. They provided, first of all, for sufficient training, stopped new hiring, provided early retirement, and gave the opportunity to other industries to move into the areas. We really did not lose labor or have layoffs during the time when the steel industry was being technologically changed.

It was only these plant agreements which were worked out with the help of the union with the early warning of those on the supervisory board, and the active part which the works councils in the different plants played during that time which gave us the opportunity to meet this challenge.

The remarkable impact in the white collar field was felt in computerizing industry and public administration. The immediate generation of information and feedback which was done by the computers enabled industry to have computerized control of materials, warehouses, stock holding, designing of industrial parts, control of personnel needs, and needed qualifications.

We had to face especially the adjustment problem of white collar workers above age 45 or 50 to such a process, because we found that the white collar worker was not able sometimes, was not willing sometimes, to adjust to such a highly mechanized and highly computerized process.

The problem of finding new jobs in this area has also brought about the need of offering new types of training and retraining. The abolishing of professions in the white collar field which used to be valuable professions for more than thirty or forty years, and the concentration of single tasks in the white collar field, created quite a number of great difficulties which we had to overcome.

By the way, even white collar work would speed up by computer. The white collar sector is no longer the sector where everybody can determine the speed at which he works.

If I take all of those as examples, my conclusion is that automation seldom covers a whole industry. Automation normally is introduced in a patchwork fashion.

Not only technological change, but the complete process of work will be affected, work will be reorganized, and the number of persons that there is a need for at the job will be recalculated.

We also found remarkable changes in qualifications and these were more or less in the erosion of skills and not the improvement of skills.

After we discussed the development with our collective bargaining committees, we felt that the union should set up technological agreements to deal with the unfavorable impact of automation and mechanization. This technological agreement addressed such issues as early retirement, hiring freezes, wage guarantees, training and retraining, internal transfer within the company without wage losses, and severance pay.

We used to strike on a number of topics. First of all, we struck on the change of the classification system, because it related to the basic ladder of skilled, unskilled and semi-skilled, and we achieved a special agreement about security of wages and classification after a strike of roughly two and a half weeks.

We also had to embark on a reduction of working time. We had the feeling, according to our bargaining with the management association, that we could not come very far below the 40-hour week at that time, so we put forth a number of other demands.

First of all, we wanted an increase in vacation time from three weeks to six. This is a shrinking of the working time over the whole year. We have been successful recently in getting a contract over all of Germany for the metal workers which provides six weeks' fully paid vacation plus 50 percent vacation bonus. This is part of reducing working time by vacation.

In another contract we had the opportunity to limit the working time controlled by management. For example, we got eight minutes for labor and fifty-two minutes for management. That means eight minutes off the whole hour were paid time for the worker, and only fifty-two minutes of work time where management was able to produce. This is part of a reduction of working time.

We were just recently able, with a Daimler Benz factory, by factory agreement, to accomplish a contract permitting early retirement at sixty, where normal early retirement in Germany is sixty-three. The factory will pay up to age sixty-three from their own funds, and this is by plant agreement.

We also had to include in our collective bargaining agreements special protection for workers, white collar workers and blue collar workers, above fifty or fifty-five years old. It differs from region to region. We were not always able to get the fifty-year borderline, so we had some of them at fifty-five and some of them at fifty specially protected according to length of service, with pay protection in case of inability to fulfill the job any longer. They were also specially protected against layoff so that they had the opportunity, with the exception of the firm going bankrupt, to stay with the firm until they reach their normal retirement age.

Those are only a few of the goals we have reached in the past. We still would like to reduce working time from forty hours to thirty-two hours. We still would like to do more within the field of humanization of the workplace, control against speedup and restrictions on more intensified work.

Also, a long-term goal of our policy in the collective bargaining field is the merger of the collective contracts of the white collar and blue collar workers to enable both sides to fight the challenge of the mechanized and automated processes in the future by having one contract and fight for that contract in a cooperative way.

This is just very briefly the way my union in Germany has approached in the last thirty years the challenge of technological change and automation. So far we are quite sure that technological change in an economy which is booming and expanding can be matched by an active collective bargaining policy. But as soon as we come into a declining sort of economy, we have to mobilize our union membership, we have to mobilize our political friends, just to make the best out of that situation that we can, because in a shrinking economy, as we have seen, it is very, very difficult to match the challenge of automation.

THE SWEDISH LABOR PERSPECTIVE

Inge Granqvist
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Swedish Trade Unions - and in particular those which organize industrial employees - had for several decades clearly stated that technological development and a continuous renewal of Swedish industry is a prerequisite for increased material and social well-being, not only for their own members but for the Swedish nation as a whole. When forming that policy, it was not fully clear that this technological development could have such far-going consequences which are apparent today. The industrial structure, the demands on professional know-how and education, as well as the structure of society were changed.

- Old, often tradition-bound enterprises were eliminated.
- Whole industries, which earlier had been the backbone of Swedish industry, stagnated or shrunk as far as volume and employment possibilities were concerned.
- New technology and higher production led to a concentration of production.
- The new enterprises required new professional know-how and at the same time old professional skills were no longer in demand.

This development was accepted for quite some years. The social welfare losses which some suffered were considered to be the price that had to be paid for a greater material well-being for the majority. Actually, it was not until the end of the 60's, beginning of the 70's, that more and more people started to question whether the price was too high. Moving of people, the thinning out of population in large areas of the country and the problems involved therein had reached proportions which could not have been foreseen 20-30 years earlier.

In spite of that, the Swedish trade unions still stick to their basic principle: that technological development, the adoption of new techniques and a continuous renewal of Swedish industry are necessary. In fact, that demand is being put forth with even greater emphasis than ever before. While the great changes during the 50's and 60's could take place without causing any real unemployment, today we are faced with the problem of unemployment. And, in our opinion, the reasoning covering new techniques and unemployment is quite simple -- either we have to accept that quite a few people - hopefully only temporarily - will be laid off as a result of efforts to strengthen the industries competitive position through the introduction of new techniques, or we shall have to risk that many more will lose their jobs - permanently - because our industry has lost its competitiveness.

We are now fully aware of the social risks and problems involved in the earlier non-interference attitude when people were moved, when there were losses of professional knowledge and lowered intrinsic value of the individual. Now when we also have to cope with an acute unemployment problem, we are trying to form a union strategy which will take advantage of the positive effects of technological development and the restructure of industry and at the same time take into consideration all the social consequences.

The motive behind the involvement of Swedish industrial trade unions, which started as early as the 30's, with problems which in other countries were controlled by politicians or not controlled at all, was dependent on some factors which perhaps are specific to Sweden. As far as population is concerned, Sweden is a small country. We have 8 million inhabitants (during the 30's this figure was 7 million) and, in spite of the fact that we do have class-distinction, our population is comparatively homogeneous.

Sweden is traditionally a free trade country. We have natural resources - ores, forests and hydro-electric power - and we early became suppliers to other countries of raw materials and semi-manufactured products. An early growing industry, with large contributions in the field of industrial supplies, contributed to strengthening the links between Sweden and foreign countries. We very early became dependent on the world surrounding us.

The Swedish industrial trade unions for the blue collar people are organized according to an industry principle (branch principle). For example, at a mining enterprise we do not have separate unions for underground miners, ore dressing plant operators, maintenance people, etc., but all are members of the miner's union. This simplifies industrial relations both between and within different branches and at the local level. On the other hand, salaried employees - whom, by the way, I represent - have other salary and employment conditions and therefore have their own union organization. But more about that later on.

Swedish trade unions have a very high rate of unionization. More than 80% of all employees in industry are members of trade unions. And during the past decades employees in the private and public service sectors have also joined their respective trade unions in ever growing numbers.

This prompts me to present a very short description of how the Swedish labor market is organized. This picture is not 100% correct but hopefully it indicates more or less completely how various organizations cover their respective sectors of the labor market and how my own organization - SIF - fits into that pattern.

On the employers' side, SAF is the strong employers' organization in private business - mainly industry. It consists of various branch organizations. There are also employers' organizations for state and cooperatively owned industrial enterprises. We have many such enterprises active in various branches. The employees in these enterprises are organized in the same trade union as those who work in private industry. Further, it can be noted in this connection that we in Sweden - in spite of 44 years of social democratic government from 1932 - 1976 - have relatively few state-owned enterprises. A large number of those companies which now are owned by the State became nationalized first after a non-socialist government came into power in 1976. This occurred in connection with a whole series of crises in some heavy industry.

There are also formally independent employers' organizations for banking, insurance and newspapers. Informally they, of course, cooperate with SAF. We also have an organization which represents the central government as employer, as well as the organization which "en bloc" represents local government.

On the employees' side, we will start with the manual workers' organization - LO. As I mentioned earlier regarding the industry side, this includes several branch organizations such as metalworkers, paper industry workers, food industry workers, etc. These unions are held together by a strong national center - LO - which presents the unions as a collective bargaining body in the private sector but which also represents the unions' joint views in matters of public interest. There are also unions, which are a party of LO, organizing manual workers in central government, local government and commercial business. In addition, I would like to mention that this homogeneous LO group is closely allied with the Swedish Social Democratic Party.

On the other hand, salaried employees' organizations are formally non-party political. Here we can start with my own union - SIF. We organize a large number of industrial salaried employees and also those in some branches closely connected with industry, such as consultancy services. We have separate agreements with each employees' organization within industry which, however, are quite similar to one another. On one side of us we have the salaried employees' union in the banking, insurance and commercial sectors. We also have in Sweden salaried employees' organizations for local government employees, as well as unions for central government-employed salaried employees such as:

- the public services union organizing within the taxation authorities, postal services, telecommunications services, etc.
- teachers
- customs employees
- military officers, etc.

Together, they all form the Confederation of Salaried Employees (TCO). However, TCO does not have the bargaining rights which LO has for some of its member organizations. TCO represents its member unions before government and the public and deals with matters of public interest such as general economic policies, tax policies, industrial policies, consumer policies, and educational policies. In addition, TCO carries out union education and other activities of mutual interest.

In addition to these TCO-affiliated salaried employees' organizations, we have an organization for first line supervisors (SALF), mainly within industry. This organization, however, claims the right to organize equivalent people in the public sector as well. A few years ago, this led to an internal union conflict with some other TCO unions, which resulted in SALF leaving TCO.

Finally, there is the Swedish Confederation of Professional Associations (SACO/SR) which organizes employees with a specific educational background, i.e., university education, regardless of whether they are active in private enterprise or in the public sector. SACO/SR has most of its members on the government side.

I mentioned earlier that TCO has no right to bargain for its member unions, because they belong to various sectors. In order to create a collective bargaining coordination body of salaried employees in industry, which could use the same pressure as LO in representing its industrial unions' cause, PTK was created by SIF, HTF, SALF and parts of SACO/SR.

Finally, we have some other forms of cooperation between union organizations, to some extent controlled by central agreements but which are mainly of importance in local work at individual work places. We have a "local shop committee" which includes all union organizations in a factory or a company and which is the employers' counterpart in matters of co-determination. We also have the Safety and Hygiene Committee at plant level which consists of both employer and employee representatives and where the latter group has the majority.

In other words, we have a network of contacts and negotiation possibilities on the Swedish labor market where the union organizations through their central organizations can be influential and protect their members' interests in overall questions in relation to the government, parliament and political parties, at the same time as they can collectively or individually negotiate with employers' organizations or individual companies. As a matter of fact, our influence on politicians has led to the passing of labor-rights laws, of which some are directly applicable when introducing new technology - to revert to the actual subject of my presentation.

These laws are:

- The Act on Safety and Hygiene
- The Act on Co-determination
- The law covering the employees' representation on the Board of Directors
- The Shop Stewards Act.

The Safety Act is definitely the strongest in this field. It forces employers to inform the union of planned changes with regard to work methods and the purchase of new machines and tools. It gives the union the possibility to study and negotiate such changes. It is interesting to note that this law gives us the possibility of studying the working environment not only from a physical point of view. The law definitely relates even to the psychological environment or, in other words, stress, isolated workplaces, etc. However, the fact remains that we have not as yet taken advantage of the full potential of the act as to bad psychological working conditions, in spite of the fact that the adoption of new techniques should prompt our watching that particular problem more carefully. We do have capable negotiators and safety representatives in many places at the local level but I can hardly believe that we have good psychological workplace environments everywhere.

The Co-determination Act states that employers shall continuously inform the union organization of the company's activities and planned development, i.e., its economy, production and plans for further long-term goals set by company management. The law also states that the company shall take up negotiations with the union before making decisions regarding technical or organizational changes. In that way, the union is given - in principle - the possibility of influencing decisions. However, I must admit that many companies consider this purely a matter of form. From the union side, we have no actual sanction possibilities other than delaying decisions by requesting central negotiations. We definitely do not have any possibilities to veto changes which we consider undesirable. But I believe that if we learn to work with the rights we have been granted by law, especially through better education of our local representatives and by using the knowledge which is available among our members, we can influence conditions out in the field by presenting good arguments.

The Co-determination Law gives us, among other things, the right to take up negotiations ourselves with employers regarding conditions which we want to be investigated or even changed and where the application of new techniques is being considered. We believe that if we utilize this possibility better, we will also have greater chances to cooperate from the beginning in the change process and influence the results in a manner which will be desirable for us. Once again, just as with the Safety Act and the possibilities for influencing the psychological working environment, also in this area we could have done better to take advantage of the opportunities available.

The Law on Employees' Representation on the Board of Directors in medium and large size enterprises should make it possible for our representatives to get an insight into and - hopefully - at an early stage can have influence on the choice and outline of new techniques. In many cases, they can insist on being informed when the company is reaching a situation where new technology can be considered and in that way - through preventive co-determination negotiations - meet the new situation.

The Shop Steward Act - just like the Safety Act - gives the union organizations the right, among other things, to train those people engaged in technical, computer and safety matters on paid working time. In our own educational centers, at conferences, etc., we can give to our members knowledge, experience and appraisals with regard to these problems.

In addition to the above-mentioned four laws, there are also some agreements which partially complement them and which are partially independent with regard to these current problems such as new techniques and how they are to be handled:

- Agreement on workplace safety and hygiene
- Agreement on co-determination
- Rationalization and social security agreement

The agreement on workplace safety is a complement to the actual law. Such an agreement we have for all industry, with slight differences for different branches.

A Co-determination Agreement has, until now, only been achieved in the state owned and cooperative industrial enterprise sector. The law - which I mentioned earlier - was actually created in such a way as to be completed by branch-wide and company-wide agreements. But in an ever-hardening climate, where employers in the private sector show a more and more rigid attitude towards our efforts to achieve increased influence, we have not come any further.

However, in the state owned and cooperative company sector we have come as far as central agreements. These are so new that they have not resulted in very many local agreements. The most important ingredient in these agreements is that the local union organizations now have the possibility to turn to their own consultant - at the expense of the company - in questions of new techniques or other changes of importance. That consultant can, on behalf of the employees, carry out investigations and explain to them the consequences of measures planned by company management. The local union is thus given a chance to enter into co-determination negotiations with a better foundation of facts.

Finally, the rationalization and social security agreements. These two have the same background and can be considered as a whole. They are valid for industrial salaried employees and their counterparts in the private, state owned and cooperative sectors. We on the union side state that we, in principle, acknowledge the necessity of rationalization in order to strengthen the companies' effectiveness. However, it is pre-supposed that rationalization will be carried out with the cooperation of union representatives. At the same time, we have acquired through negotiation a certain amount of money, equal to 0.5% of the salaried employees' salaries, which shall be deposited in a so-called "social security fund". This fund is administered by a joint board of directors. Funds shall be used to lessen the problems which arise when salaried employees are laid off or when they risk being laid off. The small staff of collaborators in this fund uses quite unconventional methods and is, in our opinion, rather effective. The methods used are as follows:

- "preventive activities"
- employment exchange, including probation employment at other companies with supplementary salary
- adjustment subsidies when moving
- retraining, eventually for a new profession
- training school for inventors
- start your own business
- early retirement

All of these measures are complements to the protective network which we developed over the years in Sweden for our citizens. I believe that with this combination of measures we have succeeded quite well in making easier the economic and - not least - the social problems which our members can be subjected to in times of change.

What do all these laws and agreements, which I mentioned earlier, add up to at a typical industrial workplace? Usually the great majority of employees are organized in unions. The workers belong to an LO member union, while salaried employees belong to one of three unions: SALF for first line supervisors, SIF for the majority of salaried workers and SACO/SR for those with university educations. The latter three cooperate regularly in a local negotiation body called PTK. Most of the contracts are carried out in the form of negotiations. When negotiating wages and salaries, LO acts on its own and PTK on its own. But in negotiations regarding production, rationalization and similar matters, all four organizations often act jointly. In addition to negotiation activities, they engage in representation on boards of directors and in safety committees. There might also be other committees for union management cooperation of a more or less permanent nature.

With regard to rationalization and other forms of technological changes, the employer periodically contacts the union at an early stage. This can be done informally or through formal negotiations. The union is usually asked to take part in investigations and project groups and usually accepts such invitations. The unions normally have unlimited access to plans, consultant reports and other such background material. The problem is more that of interpreting and understanding what can happen and in engaging members in discussions regarding future changes.

With regard to more comprehensive reorganizations of production, the union often has several chances to present its opinions, first at board meetings in connection with decisions covering foreseeable general outlines and policies and later during negotiations covering the planned changes. In addition, the choice of machine tools, machines and processes is taken up in the safety committee.

I think it is fair to say that local union representatives do not have much to complain about when it comes to access to information and opportunities to express their opinions. On the other hand, there is a great deal of criticism and complaints when it comes to possibilties of influencing employer decisions. One common comment from active union members is that earlier we didn't know what was going on - now we know what the employer is thinking of doing but we can't do much about it.

Well, back to the problems with technical change. It is quite clear that these problems will not be fewer now that practically all industrialized countries have noticeable problems with balance of payment deficits, economic stagnation, unemployment and continued technological development. However, we are not completely paralyzed or panic-striken by all the signals we receive from so-called technological experts who, referring to new technical discoveries, forecast that one or another professional group will be drastically reduced within a few years.

Forecasts of that type are not new. We have been hearing them for 10-15 years now. But in every-day life there seems to be a lot of inherent inertia which results in technical innovations not having any great impact under a short period of time. This is probably because of the present-day industrial structure, which cannot casually be adapted to new techniques. Heavy investments with long technical life span can often be considered as "sunk costs" and can therefore compete with new technology over a relatively long period of time. Further, new technology requires professional know-how, not only among a few but among many. It can therefore demand wide and relatively long-term training. But noting the inertia in the existing system should not, of course, lead us to believe that the problems facing us are easy to tackle nor that we have a lot of time to get ourselves and our members ready for new conditions.

Within our organization we have created a classification system. With it, we can classify our members, belonging to various families according to the various functions in which they are active (for example production leadership, R&D, design, marketing, economy, etc.) and according to their degree of responsibility, difficulty in work, number of subordinates, etc.

On the whole, we have just as many administrators, engineers and economists as earlier. On the other hand, we note a tendency towards a decrease in the number of lowest qualified members among which, by the way, we have more women than men. Moreover, this is an indication that the traditional jobs for relatively poorly qualified youths have decreased - probably the results of technological development which has resulted in a decrease in purely routine jobs in offices. The question is - are we as a union organization partially responsible for this situation? We have perhaps been too successful when we have gotten relatively high entry salaries for our youths and in that way contributed to the need for enterprises to mechanize more simple jobs. In other words, it is now necessary to have a higher level of education in order to enter into our sector of the labor market.

The total number of industrial employees has decreased since 1968, at the same time that the number of salaried employees has more or less increased up to 1978. In addition, we note the following trend:

1930 10% salaried employees and 90% manual workers
1960 22% salaried employees and 78% manual workers
1978 29% salaried employees and 71% manual workers

The explanation for this probably lies in the fact that industrial products now include more technology and that industrial processes have become more complex. There may be a need for better administrative routines, in spite of the fact that we now have electronic aids, and increased need for personnel work and marketing efforts. The increase in salaried employees from 22% to 29% during the period 1960 to 1978 is, on the other hand, not the whole truth. Consultancy service enterprises, which in our official statistics are not registered under the category "industry" (and many of whom are organized by SIF) have increased in number during that period. Therefore, it can be said that altogether the number of salaried employees in the whole sector of industry has increased considerably at the cost of manual labor.

This situation has, of course, been noted by the employers and we must expect that they will increase their efforts to rationalize the salaried employees' jobs. Perhaps not just to save on costs but also in order to soothe the manual workers' trade unions so that a "reasonable" balance between manual workers and salaried employees' jobs can be established. We have actually noticed signals from LO which indicate that same general direction.

At the same time, LO is designing a policy which in principle is in accordance with our own policy, namely that people should have the possibility to develop in their work and to take greater responsibility for their own work. As far as LO is concerned, this policy is directed towards greater participation by the workers in planning their own jobs. Workers shall also more often get involved in developing methods and processes. New technology will undoubtedly help them reach that goal. From an ethics point of view, we should of course support the manual workers in their efforts. At the same time, however, we are aware of the fact that such a development will take away from our members some of their traditional work duties.

Aside from these border-line problems, which might cause conflicts between white collar and blue collar unions, we see definite risks in the future when companies introduce new technical methods.

First of all, there is the purely physical working environment, which in many places will be influenced by the introduction of computer terminals, word processing equipment, electronic design instruments and the like. It is obvious that this type of equipment will present people with new - to a certain extent unknown problems - eye irritation, body fatigue by faulty work posture (which over a long period can lead to permanent injury), physiological problems caused by static electricity, hearing injuries through high-level noise. To date, we have had little knowledge of these factors or have not taken them as seriously as we should have.

We musn't be fooled by the smooth advertising brochures and pictures from manufacturers of all that new equipment, those which show young, attractive people at work in streamlined offices, with charming interiors and colors that at first glance are very attractive. We already know that there are obvious physical work environment problems at those types of work places and we should all be concerned about their long-term effects. Manufacturers would do their customers and their employees a great favor if they used some of the funds now used for marketing for the development of better equipment, equipment which is adapted to man's natural prerequisites and not equipment which man must adapt himself to.

But these flashy advertising pictures with their young, attractive and intelligent people also prompt some more questions:

- Where are all those who formerly and still today in many places form the backbone of the company's know-how and administration?

- Where is the professional knowledge which all these people have collected? Professional knowledge can to some extent easily be documented with figures, words and pictures, but professional knowledge is also personal experiences and finger tip feeling, not easily documented by hard facts.

> How are these new activities organized? How much influence do these people have over their own company? How much can they subordinate themselves to a system which they themselves have not had a chance to influence, which perhaps not even their own superiors or company management are particularly knowledgeable about but which has been created by outside experts?

It is these and similar questions which we are trying to find answers to and suggest solutions for in a computer policy program which has been set up in our organization. That program is now ready in the form of a rough draft. It will be presented at our congress later in November (1981) and will then be distributed to our locals as an aid in daily work. But we do not consider the program to be a final product. We take it for granted that the ideas in this field will develop and deepen and we expect continuous progress reports from our locals. In that way, we can keep this a vital program for continuous updating.

Our computer policy program is based on several documents and policies. One of these policies is our demand for increased influence by employees over the daily running of the enterprise as well as our long-term planning. We have opinions regarding how work should be organized in the companies; how people should be able to fulfill themselves in their work; how they should be trained in order to take on new tasks but at the same time take advantage of our professional experience.

It may sound as if we are speaking for the employers when we demand an organization form which takes advantage of the individual's various knowledge and qualifications so that they together can accomplish more than they could do individually. In this way employees, and as a result also their company, become more effective. We do not agree with the scientific management type of division of work into small, clearly defined segments which - especially in the new technical sense - can lead to employees being divided into first and second rank people. It would make the company extremely vulnerable because the company would become reliant on the special know-how of individual persons. We demand furthermore that professional knowledge and know-how not be indiscriminately fed into computer programs.

One shouldn't believe that when such knowledge has once been fed into a program then all problems are solved and that one always gets a quick and, above all, cheap answer to every question. It is true that computers can calculate quickly, but the answers they have are not better than those which would have been available in the past and which were arrived at under very simple assumptions. When an employee has fed his knowledge into a computer program and for some reason - for example, the company's short-sighted profit interest - has to leave the company (perhaps on his own free will because there are only boring jobs left) there is a great risk that the company will have no further progress. Therefore, we demand that professional knowledge be retained, developed and distributed among many in order to combat an impoverishment of work tasks of the individual employee in a company and a general decrease in the level of knowledge.

As I said, these demands can sound like those which might be formulated by an organizational consultant on the employer's side. But, as a matter of fact, we have too often seen how companies handle organizational problems and their employees' knowledge and how they desire to accomplish something in a short-sighted and unconstructive manner. Their goal has been short-sighted profits without considering the long-term consequences. The employees in the company generally have a more long-term interest, namely job security in a company which makes progress in a sensible way and in which they can reach self-fulfillment.

In our computer policy program we describe under which forms we want new technology to be introduced. We refer there to how our locals will take advantage of the opportunities which the laws of labor market and co-determination offer. We believe that the trade union/the employee/the user must be consulted and given a chance to participate in systems development long before a decision is made. As I mentioned earlier, we have the right to consider company proposals before they are implemented. But far too often all of the fundamental factors have been determined by the company in advance and at that stage we can seldom do more than say "yes" or "no" to company suggestions.

Therefore, our goal is to enter into systems development or new techniques projects at a very early stage, while there are still good opportunities for influence and effect. We also want such projects to be carried out step-by-step with possibilities for retrieval and negotiations. We want our negotiators to be given an honest chance to clearly understand how the work situation will be affected in the future. Once again, the question of training arises. Employees must be given a broad education for their newly formed jobs. And this should not entail some being given more qualified tasks while others are degraded to button-pushers. We want the work organization around the new techniques to be formed in such a way that it will make possible group work, job rotation and a great degree of self-determination for groups as far as leadership, planning and execution of the group's work tasks are concerned.

We are convinced that if new techniques are introduced in the above-mentioned way and with the goal stated here, conditions will be more humane and meaningful. We are certain that the company will also benefit from that in the long run.

Our computer policy program also contains a section covering secrecy and integrity questions. We demand, for example, that an administrative computer system should not contain data which can be considered as an unnecessary encroachment of an individual's personal integrity. It shall not either be used for processing of personal data for registers which have not been agreed upon in negotiations. The computer system shall not be set up in such a way that it makes possible performance measurement of individuals.

Naturally, we are aware of the fact that Sweden is a small country and that we are to a great extent dependent on what happens in other industrial countries. Therefore, it is natural that we import much of the new technology from other countries - especially from the USA. We import a lot of the hardware, but often the software cannot be separated from the hardware.

Software is the collection of systems and programs. It involves thinking around work tasks, production set-ups, and the shape of an organization. To a large extent, we import this from abroad. Therefore, system design, as we would like to have it and as I described it earlier, often cannot be more than system adaptation. That is why we note with great interest that in the United States you have formulated thoughts for a union program for the design of a union system.

In this special case, it is a question of a union-based CNC* system for the manufacturing industry and mainly for the man on the shop floor. A project has been outlined by Professor Bob Karasek of Columbia University. There he also speaks about the desirability, or even necessity, of international trade union cooperation in this matter.

I do believe that such international union cooperation must be established. Not just regarding a CNC system but also regarding, for example, CAD/CAM** systems and administrative planning and controlling systems. I feel that the international trade union movement should have all possibilities of success in this field. Others before us, who were many fewer in number and who had no organization behind them, pointed out and made topical the question of environmental risks. Not more than 20 years have passed since the concept of environment in its present sense was established. Today it is a commonly accepted concept which influences people's actions and thoughts and which has initiated legislation and even some international agreements. The "safe car" came onto the scene some 12-15 years ago. Today most car manufacturers have taken into account the ideas regarding greater safety for drivers and passengers.

Why then should we in the international trade union movement, considering the strength we have, not succeed in influencing both manufacturers and buyers of new technology in a direction which will have, both in software and hardware, a more human design?

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* Computerized numerically controlled machines.

** Computer aided design/computer aided manufacturing.

JAPANESE DEVELOPMENTS

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We are getting inundated nowadays with everyone telling us what we ought to learn from the Japanese, but it tends to be from the viewpoint of management, or management consultants, or what the Japanese themselves want to peddle, and it seems appropriate that we begin thinking about a trade union agenda on that issue.

In 1978 there were some 12.4 million union members in Japan. That is an organization rate of about 33 percent, well above the current U.S. rate, though far below the organization rate achieved by the Western Europeans, particularly in northern Europe.

There are, of course, considerable variations when you give an aggregate figure like that. For example, in large private sector firms unions are pretty much the norm, including over 60 percent of the workers. Seventy-five percent of the public sector workers are organized; 60 percent of employees in finance, insurance and real estate; 65 percent in transportation and communications.

There are four national union centers in Japan. There are industrial unions, some of which exist more on paper than in reality, and there are union federations in the growth industries, which provide a lot of the framework for pattern bargaining, primarily in the annual nationwide so-called spring struggle. It is interesting that they use a lot of military terms in their description of union activity.

But the basis of the trade union movement in Japan is the autonomous "enterprise union". The enterprise union covers all employees below the management level employed in a particular enterprise, or there may be a federation of unions representing the plants that make up that enterprise.

In the case of the auto industry, it would be as if employees at GM had their own autonomous union composed of locals at given plants in both auto product lines and non-auto product lines, and there also were locals at GM's primary component suppliers. They would all be in the same union and each GM local would then conclude its own contract based on local collective bargaining only within the framework of a master agreement negotiated by the companywide GM union. The industrywide auto union would provide only weak guidance for these efforts. That is what the Japanese system is like.

Let me point out some particular characteristics of enterprise unions and it will bear on our discussion of technology shortly. Blue collar and white collar workers are organized in the same union, and in fact, that goes a long way toward breaking down some of the barriers between the two groups that exist in other countries. There are no white collar unions as such except, of course, in the white collar industries.

Second, membership is limited to regular employees of the same enterprise.

Third, union officers are elected only from among the regular employees of the enterprise.

Fourth, the union shop is pretty much the norm. Regular employees automatically join the union and there is automatic dues checkoff.

Enterprise unions have some weaknesses. They are particularly vulnerable to employer domination and manipulation, with the arguments that in order for the enterprise to survive, we have to do so and so. It is very hard for enterprise unions to resist those kinds of claims by management. Workers often tend to become overdependent on the fortunes of the firm, and therefore so does the union.

A second weakness is that enterprise unions commonly lack interest in problems outside the firm, and indeed they are often rather indifferent to organizing the temporary or contract workers within their own firm.

Third, because enterprise union leaders commonly maintain their status as company employees and their term of office is quite short, Japanese union leaders, particularly at the lower levels, are far less professionalized than they would be in the United States. As a consequence, union leaders often see their union activities, particularly at the local level, as an opportunity to provide service to the company and as a means of enhancing their promotion opportunities.

There was a rather interesting survey of 134 major firms just reported in Japan. They found that 46 of those firms had as members of their board of directors individuals who had previously served as officials in the firm's enterprise union. I suggest that such expectations on the part of union officers can only be expected to weaken union defense of worker interest.

Now let me suggest to you what might be some strengths associated with this form of unionization. First, a major achievement of the postwar enterprise unions was to dramatically level the differences between blue collar and white collar employees with respect to wages, bonuses, benefits, common eating cafeterias, and first-come first-serve parking lots. There is now a strong egalitarian character to Japanese firms and the enterprise unions have had a significant role in achieving that. In fact, one of the strange things, particularly in what we think of as blue collar industries, even in heavily manual industries, is that when you meet the board of directors of the union you find that often they are graduates of the elite universities. They are not exactly folks who have come up from the line, and it gives it a very special character.

Second, although it is difficult to separate out the effects of union demands on wage increases, it can hardly be said that the rate of wage increase in Japan in the postwar period has been inferior to that achieved by Western nations. Indeed, at least until 1973 wages rose more rapidly than perhaps any other advanced industrial nation. The wages surpassed, for example, those in England and France, although they are still well behind the United States and Germany.

The whole reason for existence of the enterprise union lies in maintaining its members as employees in the company. So it is, in fact, possible to mobilize very strong resistance to workforce reductions. That strongly contributes to a sense of employment security among union members and can be contrasted, say, with the United States where surveys report that lack of employment security is one of the great concerns of our work force.

Further, because union leaders commonly come from within the firm, it is possible to maintain strong relationships between leadership and rank and file and to sustain those strong relationships. There is a certain democratic quality to these unions.

Finally, an argument can be made that the enterprise union is based on enterprise consciousness of the employees, not simply on loyalty to the employer or management alone.

You have heard that prolonged strikes are not very frequent in Japanese labor-management situations, though in fact the comparison depends, of course, on the kind of measure you use. If you use something like man days lost per worker, the Japanese rate does not look so different from, say, the French rate.

Demonstrations and work stoppages in Japan usually come at the outset of bargaining rather than at the point negotiations reach an impasse. The enterprise unions themselves as well as employers are particularly mindful of the permanent damage that a lengthy strike might inflict upon the company's market position, its production, and employment, and both sides are very careful in this context.

There is widespread and regular use of labor-management consultative committees. They are usually established by comprehensive basic agreement. They share information, and discuss and dispose of a wide range of matters that might come to be collective bargaining issues but are disposed of earlier by these labor-management committees.

There is a fairly well established set of practices for rewarding people -- that is, wages and promotions -- according to length of service, so that uncertainty over terms and conditions of employment is considerably reduced in many ways. The Japanese would argue that that reduces the need to negotiate many issues that become collective bargaining problems in the United States. For example, they have relatively little conflict over seniority rights, orders of layoff, work assignments, job rates, and technological change (unless it involves dismissal of regular employees, in which case it becomes a major issue).

There is also very little conflict over the right to organize and bargain collectively, very little conflict over the appropriate size of bargaining units or jurisdictional disputes among unions. If fact, the right to organize and bargain collectively is written into the Japanese constitution, Article 28. Apparently the Americans felt that it was very important during the occupation to encourage that in Japan. They did not seem to think it was so important in the United States.

Let me now turn to the matter of technological change in unions. I think we are in the process of creating an enormous myth in the United States about the Japanese superiority in technology. There have been a number of very prominent news reports that get wide coverage, which turn out to be just not very much based on fact. I tracked some of those down so I can say that with some confidence.

I have also spent a fair amount of time going through Japanese plants, particularly with management people, but also with some union people. Generally everyone is always surprised because they expect to see the latest thing, and what they generally find is that the Japanese are not light years ahead in fact. If you ever go to a Japanese bank and have to wait twenty minutes in order to make a simple deposit, you are aware that in many areas they are still way behind us. What one does see, however, particularly in the manufacturing sector, is often extremely good execution of known technology.

Now, that is not a trivial matter by any means, but nevertheless it is different from saying that they have leapfrogged ahead of us and there is no hope of catching up. I think there is a lot of nonsense being written on that subject. I don't think they are leaving us in the dust.

I would also point out one other aspect. I was in Japan recently and I got invited to a Labor Ministry Seminar. It was on the impact of microelectronics on employment. I spent two hours there listening to very boring in some ways but nevertheless very detailed reports gathered by a team of academics and Ministry of Labor bureaucrats, detailed microreports examining the impact of this new technology on employment. They were researching that area very carefuly. I happened to have one of the people on that group visit me last month in Ann Arbor, and he said to me, "You know, I have been going around the United States looking for research materials on this subject of the impact of microelectronics on employment. I must have just missed it. Isn't there anything?" My experience is that there is very little in the United States. A lot of people speculate but it would be nice if we had some real data here, and the Japanese work very hard in that regard.

Let me now deal with a particular set of issues that I think bear on technology and the union response. You have all heard about the permanent employment system in Japan or lifetime employment. I would point out to you that what you have heard is much exaggerated. Female workers are almost by definition excluded, and that is one-third of the labor force. Workers in small and medium-size firms have much less of a guarantee; in fact, workers in small and medium enterprises are often the shock absorbers for maintaining employment security for the elite employees in the large firms.

What kind of permanent employment system is it, for example, that between 1973 and 1977 shed one million employees in the manufacturing sector? That is exactly what they did, and if you look at where that employment came from, much of it came from female workers and workers in small and medium enterprises, as well as temporary workers.

Furthermore, permanent employment only tends to last to age 55, or at most age 60. After that, retirees for the most part stay in the labor force because of inadequate pensions and social security, and they end up seeking new jobs, usually at lower wages and poorer working conditions.

The final point is simply that there is no statutory guarantee of permanent employment. It is a norm which managers try to abide by, and workers expect them to abide by, but that means that when push comes to shove, managers indeed, do find ways of getting rid of people.

Still, to the extent employment security is stronger in Japan, to the extent that workers identify more with the firm -- and the enterprise union encourages that -- it makes it much easier for workers in unions to go along with techological change, often initiated primarily by the employer.

Of course, particularly in the private sector, the economy has been growing so fast that much of the employee displacement that might be expected to result from the productivity increase generated by new technology has simply been absorbed by increasing sales and production.

A second point is that the Japanses wage system is set up to reward age and length of service. That means that an employee can be transferred, can change the job he or she is doing, without experiencing a wage change. And all things being equal, without a job-based wage system, it makes it a lot easier again for workers and unions to go along with technological change. If they have employment security, the first point, and if their wages are not threatened by new technology, the second point, that certainly makes it far easier for them to accept the changes.

Japanese unions have not developed coherent policies toward technological change on the order of the kinds of things you hear about the Western Europeans. To the extent that the Japanese have not developed a policy toward technological change, you might appropriately ask why not. What kind of unionists are they? It seems to me that policy or lack of policy must be seen as a part of a broader tradeoff which Japanese unions, particularly in the private sector, made in the postwar period. In return for annual increases in real wages, they gave up to a great extent shop floor and office floor issues. They gave up negotiating most internal production issues. There is, for example, no contract language that deals with problems of speedup. That means they gave up to a fair extent any kind of formal veto or control over the supply of new technology.

Until recently, that bargain appears to have been a success, that is, real wages did increase very dramatically in the postwar period, and if you look at how a Japanese worker lives today compared to twenty years ago, it is a fairly impressive improvement. We might argue about whether they have really received their full share, which would be hard to document as clearly, but nevertheless it is clear that they have gotten a fair amount out of that bargain.

I would argue that by giving up control they may have given up too much and it may come back to haunt them. Right now the rate of economic growth has been reduced significantly in Japan. It may look good to us now, but compared to what they were growing at, now they are only growing at about four percent a year, and international competition has heightened.

So management finds it much more difficult to easily insure those annual increases in real wages. I think one of the interesting possibilities over the next few years will be to see if the unions turn more towards bargaining over internal issues such as control over technology, now that that bargain cannot be maintained as easily as in the past.

Although there is no systematic union policy toward the new technology, there is a rather extensive labor-management consultation system through committees both at plant and higher levels as well which do often deal with the issue of introduction of new technology, how it should be handled to minimize disruption, and how displaced workers should be treated. In large firms it pays for management to invest in retraining because they have to make productive use of the people that are going to be with them, at least up to age 60.

The union reps on these committees may have no formal veto rights, but they do exercise considerable informal influence over decision-making. I think as Americans we might sneer over such informal influence and trust only formal control guaranteed in contracts. In the Japanese context, we should not be too hasty in underestimating the union power that comes with this informal influence, given the kind of cultural emphasis they place on consensus. I have been in companies where those labor-management consultation committees are simply paper, they go through the motions, and I have been in other Japanese companies where I think they really have some substance. It is hard to generalize about how effective they are.

A footnote here, incidentally. We hear so much today about Japanese participation in decision-making, with quality control circles being all the rage. I would suggest that the labor-management consultation committees, even without formal veto rights, may well provide far more participation for Japanese employees than the quality circles which are so highly publicized in all our management journals. In fact if you look at those quality circles they often have a certain coercive aspect to them. Workers are pressured to participate. There are Japanese surveys that show that many of the workers, anywhere from a third to a half, see the circles as a burden imposed upon them by management. And there is an awful lot of ritualized compliance on the part of workers. They go through the motions making trivial suggestions to get management off their back.

That is a far cry from the participative ideology that we are constantly bombarded with nowadays. Incidentally, the Japanese unions are almost totally uninvolved in the circle activity. There is a real difference between those and the labor-management consultation committees.

That was not an argument for U.S. unions to dismiss quality circles. I think we can draw different lessons from that, and this will get us too far afield to discuss it, but it seems to me that unions ought to be involved in making sure it does not end up like the Japanese situation.

Let me just suggest very briefly some areas where I think we would benefit considerably from the Japanese experience.

The first one is a general one which has to do with the size of wage differences between top management and middle managers, or between management and workers, because those wage gaps are much smaller in Japan. If U.S. managers are calling for U.S. workers to take wage cuts and reduce working conditions so we can compete better with the Japanese, then like the Japanese, American management should be cutting their own wages in the name of equality.

Second, U.S. managers are always pointing to the flexibility Japanese managers have in making job assignments, particularly with respect to the introduction of new technology. They are increasingly asking U.S. unions to allow take-aways of often hard-fought contract language, particularly in local work rules, to allow U.S. management the same flexibility. But the point is that in Japan that flexibility is closely linked with job security. If there is job security for employees, then management also, I would add, would have the incentive for retraining. That is, if they have to keep those employees around, then they are much more likely to buy into retraining as it is required by the new technology.

So I think what can be said to management is, if you want workers to cooperate more in raising productivity and accepting new technology, then provide the job security that will make this possible.

In a similar vein, in Japan there is substantial evidence that Japanese managers have decentralized a lot of decision-making to give workers more control over their own workshops and offices. We need to think more about who controls that new technology and how it is used.

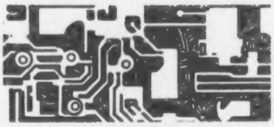
There is a tremendous stress in Japan on multi-skill formation rather than the deskilling which particularly seems to be favored by U.S. managers. Again, that multi-skill formation can become a useful model and one that better serves union and worker interests than management interest.

We need to think about what are the things we can learn from the Japanese, but they are not always going to be the kinds of things that U.S. management or the Japanese management are telling us that we ought to learn. We need to do some of our own homework to get at that.

SILICON, SATELLITES AND ROBOTS

The Impacts of Technological Change on the Workplace

Edited by
Dennis Chamot and Joan M. Baggett



While modern technological advances have contributed enormously to the enhancement of our lifestyles, they are also taking their toll at the work place. A new electronic device hailed as a time-saver by a plant manager may also result in massive unemployment. As machines become obsolete because of such advances, so do their operators. Highly specialized jobs which they are not trained to perform are often created. Manpower requirements may be drastically reduced or perhaps eliminated entirely. The idea of working side-by-side with a robot is no longer merely science fiction.

Such developments are not limited to any one segment of the work force. Clerical, professional and technical jobs are also being transformed. Many modern plants and offices bear little resemblance to their counterparts of twenty or even ten years ago.

Labor unions must play a key role in dealing with some of the serious problems which are being created for our members in the name of progress. Recognizing this responsibility last June, the AFL-CIO's Department for Professional Employees (DPE) sponsored the first major national labor conference dedicated to "The Impact of New Technologies on the Work Place."

Rodney Bower, president of the International Federation of Professional and Technical Engineers, AFL-CIO, and chairman of the DPE's Committee on Scientific, Technical and Engineering Personnel (STEP), deserves credit for his leadership in this important endeavor. We hope that the dialogue launched by this conference will be the beginning of a major effort to meet the challenges confronting today's workers.

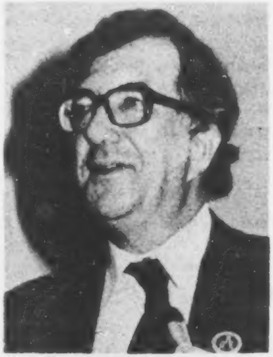
Albert Shanker, *President*
Department for Professional
Employees, AFL-CIO

As a speaker at the DPE St. Louis conference on the impact of technology on the workplace, I was extremely impressed by both the extensiveness of the participation and by the enthusiasm of those who participated. These factors indicate a widespread awareness that we fail to keep abreast of the impacts discussed at our peril—and at the peril of American society generally.

The maximum development of the human resources of this Nation's work force is the most pressing challenge we face. Unless we know how the technological aspects of work in the future will interact with the human aspects, we will fall short of our economic and social potential.

In everything we are doing now at the Employment and Training Administration, we are stressing above all else the overriding importance of increasingly involving the private sector—labor, business, education, and community organizations—in the critical tasks of job creation and skill training for the days ahead. I hope that these published proceedings will help prompt you to explore what you can do to carry out some of the recommendations which came out of the DPE St. Louis conference.

Ernest G. Green
Assistant Secretary for Employment and Training
U.S. Department of Labor



Albert Shanker

Ernest G. Green

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Introduction

Technological change has been with us since the discovery of fire and the invention of the wheel. In more recent decades, workers have had to adjust to constantly changing situations, as increasingly complex machines were introduced throughout the American economy. While for the most part unions have been quite successful in dealing with these changes, the quickened pace of current developments are cause for serious concern.

The widespread application of computers, silicon chips, and industrial robots, and the speed with which these and similar technological advances are being developed, portend vast changes in all segments of the workplace. Not only are traditional crafts and production jobs being transformed, but many white collar and professional activities are also being affected by the advent of the "paperless" office, computer generated engineering designs, electronic teaching machines, satellite communications, and so on. In essence, our society is involved in a rapid and massive redesign of work.

The articles contained in this book are evidence of labor's concern that such changes be the servant, not the master of the general welfare. They are based upon presentations at a three day conference on the impacts of new technologies on the workplace. The conference, sponsored by the Department for Professional Employees, AFL-CIO, was held in June, 1979.

Our authors deal with many aspects of the problem.

Dr. Eli Ginzberg, Chairman of the National Commission for Employment Policy, and an internationally renowned expert on employment policy, looks at historical effects of technological change, and its impact upon the structure of the American workforce. His remarks are followed by two presentations, by Paul Fox and Roger Nagel, which summarize current technical developments in the broad areas of telecommunications and industrial robots. While these articles give a brief survey of only two areas, they hint strongly at the potential extent of new developments in other areas.

The next three articles, by Dr. Mark, Assistant Commissioner of the Bureau of Labor Statistics, Mr. Haynes, Director of Cooperative Technology of the Commerce Department, and Mr. Henle, Deputy Assistant Secretary of Labor, offer an insight into the views of some of the government agencies which are most concerned with labor and industrial issues. Dr. Ginzberg offers his comments on these papers, from a different perspective.

Starting with an article by Tom Donahue, Executive Assistant to the President of the AFL-CIO, we get a closer look at these same issues through the eyes of labor.

Glenn Watts, President of the Communications Workers, Fred Kroll, President of the Brotherhood of Railway and Airline Clerks, and William Schroeder, Vice President of the Graphic Arts Union, discuss the enormous changes that have faced their members in the communications, railroad and printing industries, and how their unions have tried to deal with them. Elizabeth Jager, Economist in the Research Department of the AFL-CIO, looks closely at international problems derived from the export of U.S. technology.

Following these articles are summary reports from some of the workshops conducted at the conference. These workshops, which involved union people from 16 different national unions and all parts of the country, dealt with contract protections, education and retraining, and quality of worklife issues. Included in this section is a presentation by Reese Hammond, Director of Education of the Operating Engineers.

Coping with the extensive technological changes forecast by the above writers requires not only the efforts of organized labor but other elements of our society as well. In some areas, the active assistance of the national government will be needed. For insights into what that role could be, we were pleased to have as speakers in the closing session of the conference Ernest Green, Assistant Secretary of Labor for Employment and Training, and Dr. Thomas Moss, Staff Director and Science Advisor to Congressman George Brown, Chairman of the House Subcommittee on Science, Research and Technology, and board member of the Congressional Office of Technology Assessment.

Concluding our conference and this book is Jack Golodner, Director of the Department for Professional Employees, AFL-CIO, who provides a summation and some final comments.

We look upon this conference as part of a continuing concern of the Department for Professional Employees with technological developments and their impact on the lives of working people and their families. We offer this book in an effort both to alert people to coming changes, and to provide a source of materials to form the basis of further discussion, study and, hopefully, the development of ways to cope with these changes in a manner that best serves our nation and its people.

I would not want to close without mentioning that this conference was organized by the Department's Committee on Scientific, Technical and Engineering Personnel, under the leadership of its chairman, Rodney Bower, President of the International Federation of Professional and Technical Engineers. Thanks are also due Joan King of this Department who handled a good many of the logistical details and day to day aggravations involved with putting on a conference of this size.

Finally, we want to thank the Employment and Training Administration of the U.S. Department of Labor. Publication of this conference report was partially supported under a grant from the ETA under Title III, Part B, of the Comprehensive Employment and Training Act. Points of view or opinions stated in this document do not necessarily represent the official position of the Department of Labor.

Dennis Chamot
Assistant Director
Department for Professional
Employees, AFL-CIO

Washington, D.C.
September, 1979

Technology: Is It Good for American Workers?

Eli Ginzberg

Every modern economy is in constant change and is being influenced by changes from a great many different directions—international competition, national relocation patterns, public policy, the environment, labor-management relationships, demography—the list is endless. One of the changes that has a tremendous impact on an economy is technology.

When I went to Japan in the mid-60's, it was clear to me that the Japanese had used that fact very well. They had combined international trading and technology to rebuild their economy from the devastation of 1945 based on 3,000 technical agreements with American industry. The Japanese understood that if they could borrow and build on other people's technology, they could go quite a distance.

Historically, U.S. labor has had a very open and generally constructive view toward technological change. The reason for this is that, by and large, the American workers were not frightened that technology would cost them their jobs.

As you got more technology, the prices got cheaper, and as the prices got cheaper, the demand for the products went up. The workers felt that they would be able to get some part of that increased productivity. We had a colossal economy with a market capable of expanding which made American labor much more open to technological change than labor in other countries.

When a machine replaces an individual what happens is largely determined by what is happening to the demand for the product. For example, the individual may be retrained in some other kind of work if the total demand for the product has gone up.

We cannot say that nobody will ever be displaced by a machine, but the real question is whether the conditions of displacement are such that you have some forewarning, dismissal wages, retraining possibilities, and other things of this nature.

While it is the union's job to protect the worker, if the union tries to protect all of the workers too well without taking technological and economic changes into account, you won't have an economy that will be able to produce at all. You can't stand in this kind of a world and say "I'm not interested in new technology." You won't be in the ball park. You must work with management and government and do what you can do on the feeding in and the adjustment mechanisms.

Eli Ginzberg

In 1946, I wrote a book called *The Human Economy*, in which I tried to make the point that ours is neither a capital economy, nor a technological economy. It is a human economy.

National income earned in 1978 was 1.7 trillion dollars. This is just the income earned, not the gross national product which takes into account the amount of capital we consume in getting our incomes.

Out of this 1.7 trillion, wages and salaries accounted for 1.1 trillion with fringe benefits accounting for another 200 billion, and self-employed or proprietor's income accounting for another 100 billion. This means that 1.4 trillion out of 1.7 trillion dollars, or 82 percent, is basically wage-earning.

In other words, if something is important to the economy, it's got to affect labor because that's what the economy is all about.

What has been happening to employment during the past three decades of change? In 1950, we had 60 million people at work and in 1978, we had 95 million.

At the beginning of the American experience, everybody was in agriculture except for a few tradespeople and a few people in shipping. In 1950, we had over seven million people working in agriculture and today we're down to a little over three million. So, we've had more than a halving, a decline in agriculture which had already reached a low point by the end of World War II or 1950.

In the big manufacturing sector, which we really think of as the cutting edge of the American economy, there were 15 million people at work in 1950. From 1950 to 1969 during the long period of the post-war boom, we added five million people—a 33 percent increase in employment. Since 1969, not a single person has been added in manufacturing in the United States.

So, our manufacturing now represents just over one out of every five workers. Agriculture represents one out of 33 workers. This means that the whole expansion in the economy in terms of employment has been overwhelmingly in the service sector. If you add agriculture and manufacturing together in 1950, you had 22 million and in 1978 you had 23 million. No change at all.

On the other hand, look at the three big service sectors—wholesale, retail and government. In just those three service sectors combined, we increased from about 20 million to about 50 million people from 1950 to 1978. So, the big increase in American employment has been in the service fields.

When you look at productivity, however, you can see that we have been getting much more manufacturing output than we have been getting increases in employment. For instance, in the period from 1950 to 1969, we had an increased output in manufacturing on an index basis of about 150 percent, yet employment went up only about 33 percent. Even in the most recent period when there was no increase in manufacturing employment, the index of output went up at least a third. So that's the way in which technology has been operating in the manufacturing arena.

In fixed dollar terms, the value of goods produced from 1950 to 1978 went from about 260 billion dollars to 650 billion in manufacturing. That means that a 33 percent increase in workers also gave us about a 150 percent increase in the value of output.

In the services sector, which is very labor intensive, we went from about 206 billion dollars in the base year of 1950 to 633 billion with 30 million new workers to give us that kind of output. So, for slightly more output

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Dr. Eli Ginzberg, *Chairman*
National Commission for Employment Policy

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DEPARTMENT FOR PROFESSIONAL EMPLOYEES
AFL-CIO

Eli Ginzberg answers a question

gain in services, we used almost six times the number of workers than we did in manufacturing.

In terms of the future employment prospects in the services sector, I think we have to figure out if we have enough valuable services to export. For example, Citicorp earned 80 percent of all its profits not in the U.S., but overseas. I'm sure that this is increasingly true for a large number of American companies. We are now exporting management consulting services overseas. We have banks and lawyers overseas as well. This all shows that as a country we are becoming increasingly internationalized and one of the things that we are internationalizing is our services.

These are just a few of the tremendous changes we've had from 1950 to 1978 in the American economy. If you look at agriculture, manufacturing and services, this has been a fantastically dynamic period.

Was technology for good, for bad, or for what? Were we able to live with these rapid changes? How many people really lost their jobs because of technology?

For this last period, I think it would be hard to argue that technology was anything but, in general, a boon to the American public and to the American worker. That doesn't mean that I couldn't name some bad things that happened from that technology. If you take the big cities, we've probably got too many people forced off the farm too fast, and that's one of the reasons the inner cities are in the amount of trouble that they are. If we had been able to slow down a little bit, it might have been better.

There is very little that technology can do to agriculture any more. We're down to three million workers, and we not only feed ourselves, we also feed a good part of the world with those three million.

We are now coming to ask the question, what about the computer revolution? That's what we are really facing. That's where the people are. It's in the white collar world.

I believe that employers have no opportunity to keep their costs under control except by trying to get rid of people in that area, or trying to get more work out of the people they've got.

One of the tricks employers are trying in the service industry is to push more of the work onto the customer, and then they don't have to pay at all. Take restaurants, for instance, they charge you extra so you can serve yourself even if your food is cold or you can't find the waitress for more coffee.

Look at the gas shortages. We may be spending most of the rest of our lives in lines. That's one way to make sure that the economy's demand and supply for goods will balance out. The Russians have been doing that for 50 years. They don't have any trouble with shortages because they make you wait so long for what little consumer goods are available that people get tired of waiting and go without—a perfect way of rationing.

What will technological changes do to the length of the work week? In our Commission, we have a report coming out on this subject called "Time and Employment," and in this report, we looked at all kinds of dimensions of time adjustment, workday, work week, work year, and work career. My general opinion is that we will see in the next time period probably more pressure on the reduction of the work year. We have already been reducing the work year through longer vacation times.

A lot of workers want more control over their lives, and one of the ways you get more control over your life is with flexitime and with less time on the job. I've always thought that you cannot necessarily make a job wonderfully interesting, but you can cut the hours that you've got to be in a job that you don't want to be in.

I would say that we do not have an option about just fighting technology. We're not going to be Luddites—the people who broke the machines in the early 19th century in England. What we must do is to work out more intelligent and better joint labor-management ways of bringing the machines into the workplace.

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Satellites and Chips Transform Telecommunications

Paul Fox

Today, a small hand-held calculator, which you can buy for less than $500, has more computational power than did the first computer built in 1945 (ENIAC). It filled a whole room with 30 large units, with 18,000 vacuum tubes, and consumed 140 kilowatts of power, or roughly what you need to drive a 150 horsepower motor.

The driving force behind this, and most of the other technical changes we've seen in electronics in the past few years, are the advances in integrated circuits—the tiny pieces of silicon that contain the electronic circuits in everything from computers to portable radios.

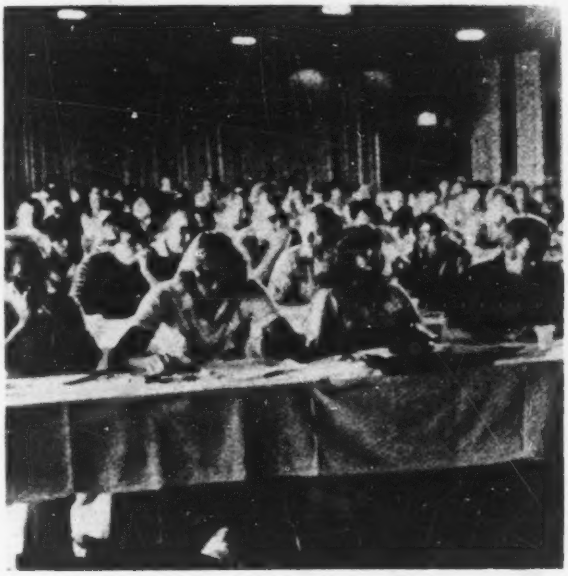
Integrated circuits have, and will continue to, dramatically decrease in cost and in size while they increase in reliability. In terms of cost reduction, the rule of thumb is that every doubling of cumulative volume cuts production costs by a quarter, and they just keep coming down in size.

As an example of the reliability increases, one particular circuit increased in reliability 200-fold in five years. That means that in each year this circuit was three times more reliable than it was the year before. You simply could not have the large scale computers we have today without the dramatic increase in reliability.

In some ways the most important advance in integrated circuits is microprocessors, which are simply an entire computer on a single silicon chip. Reasonably complex microprocessors run five to ten dollars a chip, while even simpler ones can be a dollar or two and it is expected that the price will come down even more.

There are some obvious uses of microprocessors—hand-held computers, electronic games, programmable microwave ovens that do everything but wash the dishes—all have a microprocessor in them.

But there are going to be less obvious uses of microprocessors. Soon every car will have one to control the fuel cycle. Test equipment will have a microprocessor to control and process information. Machine tools will all have microprocessors. With the cost of microprocessors and the reductions that can be anticipated, anything that needs electronic control at all might as well have a microprocessor.



Dumb equipment, which is equipment without programmable microprocessor controllers, will no longer make sense. For example, there will be no point to building an electric typewriter without putting a microprocessor into it and having it in control of things.

The effects on the other areas of electronics are similarly dramatic. Stereo equipment, microwave communications, telephone switching systems—we are going to see the complete substitution of electromechanical equipment by integrated circuits.

We do not see the integrated circuit industry maturing and stabilizing. The dramatic improvements of the past are going to keep coming, at least in the next five to 10 years.

In looking at the utilization of domestic communications satellites, it is helpful to review some of the key dates to see how fast this field has developed.

In 1945, Arthur Clarke, the author of *2001* and other science-fiction works, wrote an article suggesting the possibility of synchronous satellites. In 1957, the Russians launched the first satellite, and in 1962, NASA launched the first communications satellite, Telstar, which had been built by the Bell System.

In 1963, we had the first synchronous orbit satellite (Syncom), which is a satellite that stays in one place so that you can always point your antenna to the same place in the sky. That ability is critical for the low-cost communications satellite systems of today. It's important to realize that until Syncom was launched and worked, there was grave doubt as to whether it would be possible to have a synchronous satellite.

So up until 1963, there was significant technical doubt as to whether it would be pos-

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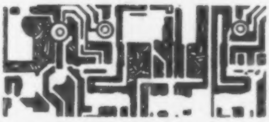
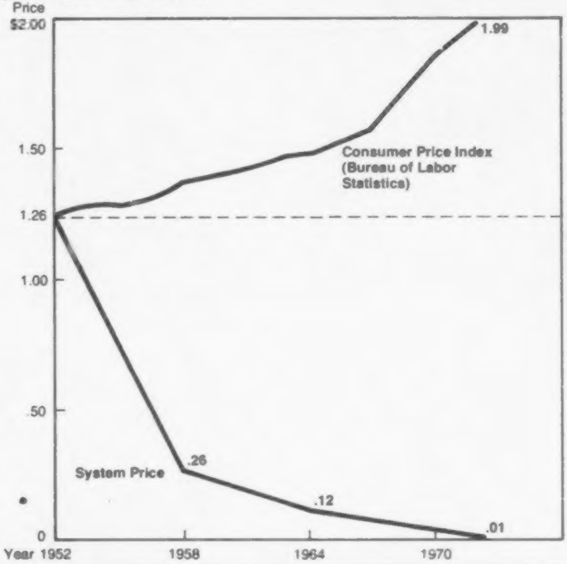
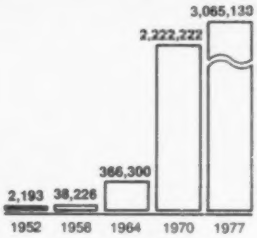


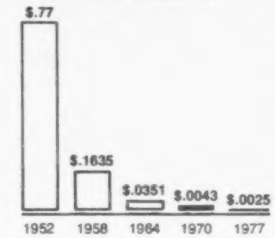
Consumer Price Index and Data Processing System Price per 100,000 Multiplications



Improvements in CPU Performance CPU Processing Speed (Multiplications Per Second)



Improvements in CPU Performance CPU Processing Price Reduction (Per 100,000 Multiplications)



sible to have low-cost communications systems. In 1972, the FCC adopted the policy for domestic communications satellites which stated that anyone who was technically and financially qualified could put up a satellite.

In 1974, Western Union launched the first domestic satellite, Westar, and then we started seeing the utilization of them. In 1975, Home Box Office, which is a pay cable service, went up on the satellite. In 1976, we had our first of what we call a "super station", Channel 17 in Atlanta. In 1978, Public Broadcasting Service started using the satellite to deliver programs. This year (1979) we will also have National Public Radio using the satellite.

Two key developments that made all of this possible were stationary satellites, geostationary orbits, which was Syncom in 1963, and the tremendous reduction in the cost of earth stations, especially receive-only earth stations. We went from over $200,000 in 1973, to today, when Scientific Atlanta will install one in your back yard for $20,000. While $20,000 is probably a little high for the average person to put it in his back yard, it's certainly not at all unreasonable for a cable system, a television station, or any other major user.

In radio, the National Public Radio is going to use the satellite, Mutual network is using it, AP Radio—the list goes on and on. In addition to the ease of making radio networks, you also have much better technical quality.

"Super stations" are where a station is received off the air, beamed up to a satellite which beams it back to earth for cable systems to receive and distribute it to their subscribers. The first one was WTCG in Atlanta, owned by Ted Turner. There are already three more that I know of, and there's more coming.

There's even a super station in radio, WFMT in Chicago, which is a classical music station. The result is that people all over the United States are watching an Atlanta station. Clearly a personnel compensation arrangement, based on the assumption that Atlanta TV stations will only be received in the Atlanta market, is an obsolete technique.

There is also cable programming delivered by satellite. This is programming sent directly to the cable systems, for delivery to cable subscribers. There are advertising-supported networks developing—in a sense of competi-

Left to right: Dennis Chamot, Ernest Green, Rodney Bower, Jack Golodner

tion to the networks. There's a whole choice of religious-family-oriented viewing. There's also a whole host of pay-programming where you are charged an additional fee for the programming.

This is clearly an expanding market for programming. St. Louis only has five television stations, for example. A cable system can easily carry 35 channels. So, we're going to see a tremendous increase in the demand for programming.

In terms of telephone service, satellites augment regular service in the 48 states, and in Alaska almost all of the long distance calls will go over a satellite. In printing operations, Time Magazine and the Wall Street Journal use the satellite to send their copy from editorial offices to printing plants and much more of this can be expected.

There's a plan to use a satellite as a relay point, so that mobile radio units can communicate via the satellite. This is particularly useful in rural areas for the police, ambulances, and emergency services. Also, long-haul truckers will be able to communicate with their terminal.

With electronic message services, the office of the future will not be self-contained either since all of the machines will be communicating with each other over telecommunication paths. Future facsimile machines will communicate in pages per minute, rather than minutes per page. With teleconferencing, a large amount of the business travel for conferences can be eliminated by good telecommunications arrangements.

There are a couple of plans before the FCC that involve electronic message services, high-speed data transmission, high-speed facsimile, and teleconferencing. One is Satellite Business Systems (SBS), which is owned by IBM, Comsat and Aetna.

Their market is large industrial corporations and what they plan to do is put an earth station directly at the customer's facilities, completely bypassing any connection with the local telephone company. The service they plan to offer is a high-speed digital link between the various locations in the company, which will be used for plain telephone service, for electronic message service, interconnecting the computers, and high-speed facsimile. They expect that all of the intra-company mail will use the surplus communications capacity at night, with high-speed facsimile machines. They'll also be teleconferencing between the locations.

Xerox Corporation's plan is called XTEN. Instead of putting the satellite terminal at the individual user location, they will use microwave radio to interconnect the customer office locations with a central point, which will then interconnect between cities, using a satellite, and, again, completely bypassing the local telephone company. Xerox's main goal is the electronic message service. They feel that such a facility is needed to interconnect the offices of the future.

Direct broadcasting, where you broadcast from a satellite directly to the home, is another field. There are no significant technical uncertainties left. The Japanese are already doing it. Whether we will actually do this or not is a regulatory and business question, but there is nothing technically infeasible about it.

In this article, I have purposely avoided discussing blue-sky ideas that require significant technical work. Most of the things I have talked about are already happening. Only a few have any uncertainty left in them. What new technological advances will come in the future, I leave to you to speculate about.

The views expressed are those of the author and do not necessarily reflect the views of the Federal Communications Commission

Robots on the Assembly Line

Roger Nagel

Robots are now commercially available and there are several thousand installed in various American industrial plants. I will, in this article, explain the basics of robotics, discuss robot capabilities, and describe some of the future trends as seen in the research laboratories.

Let's begin by defining a robot. A robot is a programmable device, that can perform various tasks of manipulation under the control of a program designed by a human being and stored in a memory device.

A robot as it is currently found in industry is nothing like the robots found in the movies, such as R2D2. Rather a robot is simply a mechanical arm which can move about in a limited work area. Robots can neither walk, talk, nor think. They perform simple tasks in a deterministic fashion, and bear little or no resemblance to the science-fiction robots.

There are three major components in a robot: a controller, a mechanical arm, and a power supply. The controller sends signals to the arm directing it to assume one of a finite number of possible positions, the arm sends signals to the controller informing it what position it is in, and the power supply provides the energy to move the arm. The controller is also capable of limited communication with the outside world. This provides an elementary method of coordinating the robot's operation with other machines in its environment. These relationships are illustrated in figure 1. In addition to the arm, there is usually a very primitive type of hand or end of arm tooling attached to the robot. The hand is generally not part of the robot as purchased from the manufacturer, nor is it permanently attached to the wrist of the arm. This is to allow the robot to have a hand designed for the particular task it is performing. The hand is controlled by the same device which controls the arm and typically can only perform a simple operation such as open or close. Because the hand design is usually dependent on the task to be performed and is often changed, it is generally called an end effector and is designed by the user rather than the manufacturer.

The mechanical arm of a robot has from three to six degrees of freedom. Each degree of freedom corresponds to an axis of motion of the robot. In general, the first three axes are used to position the arm, while the remaining axes orient the wrist. The exact location of a robot arm at a particular instant in time is specified in terms of joint positions, where each joint value represents a specific location on an axis of the robot. Typically the robot is constructed with a combination of rotary and translational joints or axes. A rotary joint corresponds to circular motion specified in degrees, while a translational joint permits in/out motion, and is specified in distance units.

The volume of space that can be reached by a robot is called the work envelope. The configuration of the first three axes determine the limits of the work envelope and are used to categorize robots.

There are three common configurations in industrial robots. In figure 2, a robot with a spherical work envelope is depicted. The first and second axes are rotary and the third is a translational axis. The robot's motion along any of its axes is typically limited to some portion of a circle for rotary axes, and similarly to some finite distance on translational axes. These limits of motion are illustrated in the figure. The circularity of the first two axes determine that the work envelope is a sphere, while the third axis determines the radius of the sphere. Both Unimate and Prab make robots with a spherical work envelope as shown in figure 2.

The second type of robot has a cylindrical work space as seen in figure 3. In this case the first axis is a rotary axis, while the second two are translational axes. The robot arm goes up and down in a vertical fashion which defines the height of the cylinder, and in and out to define the radius. The Versatran and Autoplace robots have cylindrical work envelopes.

The third and last type of work envelope is called jointed spherical, and is shown in figure 4. Here all three of the axes are rotary joints. In this configuration there is a joint in what might be considered the middle of the arm. Because this type of robot arm closely resembles a human arm its parts are sometimes referred to in human terms. For example the terms shoulder and elbow appear in figure 4. The Cincinatti Milicron T3 robot and the Asea robot have the jointed spherical work envelope.

Robots are also characterized by the number of different positions in their work envelope which can be addressed. The simplest form of robot is called a non-servoed robot and has the following characteristics:

- Arm runs at maximum velocity until a physical stop
- Usually only two stops per axis
- Low cost and limited flexibility

Although these robots have only a small number of positions at which they can stop in their workspace, they perform well and there are many of them in use. They are sometimes called "pick and place", "bang-bang", or "point to point" robots because each axis has only two addressable locations. The non-servoed robots are found in a wide variety of applications such as:

- Die casting
- Forging
- Part transfer
- Injection molding
- Machine loading/unloading

The non-servoed robots are easily programmed because of the limited number of possible arm positions, and can be sequenced with other machinery in their environment. Shown in figure 5, a Prab robot (non-servoed) is unloading a plastic injection molding machine. Although not shown in the figure, the robot takes the can to a ramp and rolls it down to a human operator to be stacked. Such an application is typical of the tasks performed by a non-servoed robot.

A more powerful class of robots are the servoed robots. The key difference lies in the fact that each joint is servoed and the robot is not limited to two positions on each axis. The major characteristics of servoed robots are:

- Position encoders on each joint and servoed valves
- Arm moves and stops anywhere within axis limits
- Usually large program memory
- Smooth motion, high flexibility
- Multiple programs in memory simultaneously
- Expensive

Dr. Roger N. Nagel, *Computer Scientist*
National Bureau of Standards
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Servo robots have position encoders or resolvers to allow the specification of mid-axis locations. The number of these locations is dependent on the resolution of the encoders. A typical servoed robot can achieve accuracy of about .050 in. in position location. Due to the large number of addressable points in the work envelope these robots are generally equipped with a large program memory. Typically a main program and several error recovery programs are stored at the same time. In general, an error program can be started by an external signal. Servo robots range in price from $30,000 to $120,000. It is worth noting that the purchase price of the robot does not include installation or site preparation, both of which can be expensive.

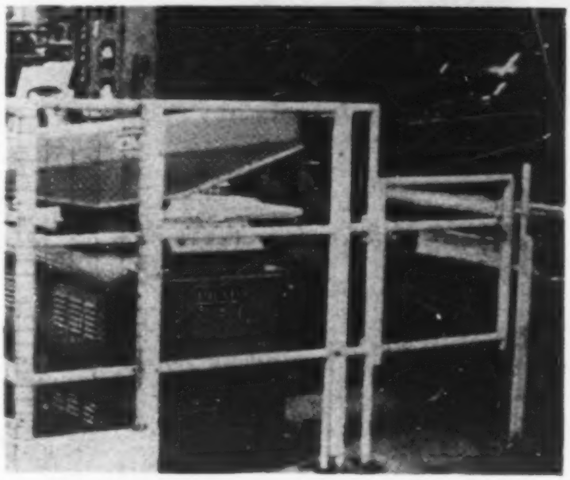
Servo robots are found in a diversified set of applications. In the list of these applications you will find some overlap with the list for non-servoed robots. The duplication arises both from the fact that in some cases a less powerful robot would also do the job, and that robots are programmable and don't have to do the same job for their entire life cycle. Typical applications for servoed robots are:

- Die casting
- Investment casting
- Forging
- Injection molding
- Stamping
- Machine loading/unloading
- Material handling
- Welding
- Tool handling

There is another class of robots called continuous path robots. These robots are especially equipped for operations which require smooth and precise motions, such as painting, spraying and arc welding. The major characteristic of these robots is the ability to record and play back very large programs. Thus continuous path robots are similar to the servoed robots, except in the memory size of their controllers and the way in which programs are recorded.

Let's now discuss the method of programming for the various types of robots. For simplicity we will assume that a robot program is a sequence of points in the work envelope. Therefore, a robot executes a program by moving in the proper order through the sequence of points.

In the case of non-servoed robots the number of possible points is limited to two



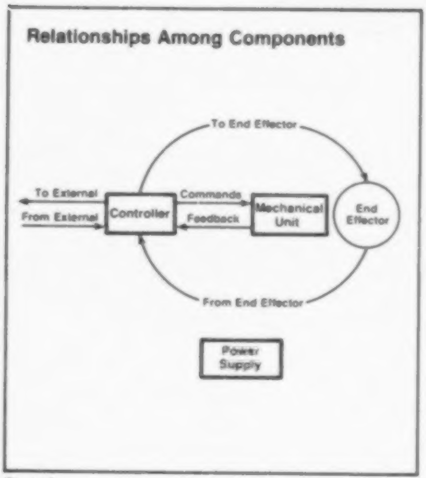

Relationships Among Components
To End Effector
To External
From External
Controller
Commands
Feedback
Mechanical Unit
End Effector
From End Effector
Power Supply

Figure 1

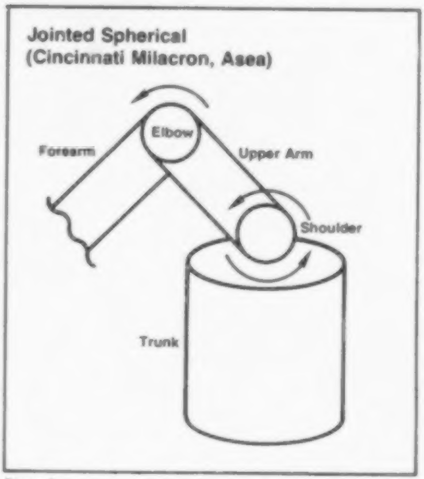

Jointed Spherical
(Cincinnati Milacron, Asea)
Elbow
Forearm
Upper Arm
Shoulder
Trunk

Figure 2

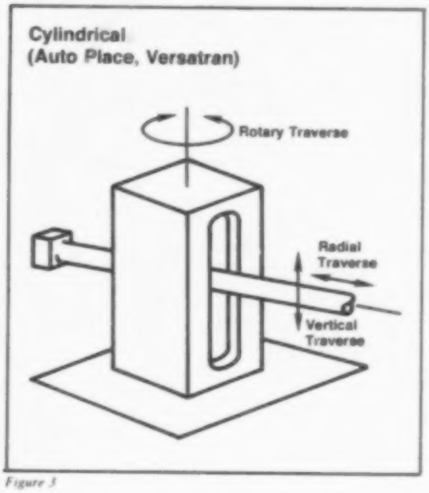

Cylindrical
(Auto Place, Versatran)
Rotary Traverse
Radial Traverse
Vertical Traverse

Figure 3

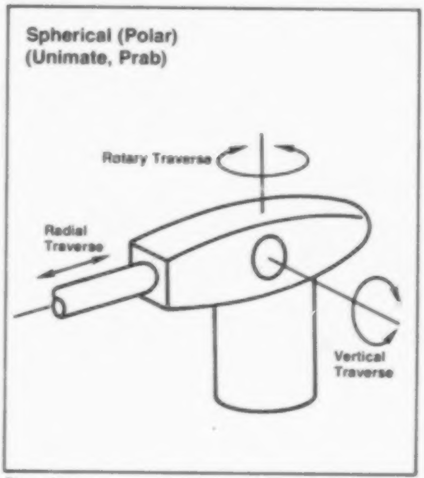
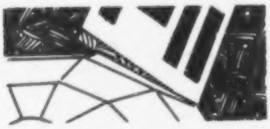

Spherical (Polar)
(Unimate, Prab)
Rotary Traverse
Radial Traverse
Vertical Traverse

Figure 4



times the number of axis or joints. Therefore non-servoed robots have very simple controllers. Typically a plugboard serves as the program memory, and the program is defined by a connecting sequence of jumper wires. In figure 6, the controller for an Autoplace robot (non-servoed) is shown. For this robot the controller uses pneumatic tubes to record the joint positions and program sequence. The operator specifies his program as a series of steps, where each step specifies the location of each joint at one of the two possible locations. Also associated with each step is a command to wait for an external signal, generate an external signal, or to go unconditionally to the next step.

Servo robots are programmed with a teach box. In general, a teach box will have two buttons for each axis of the robot (one for each axis direction), and a record button. The operator programs the robot by moving each joint individually until the robot is in a desired position. He then records that position and moves the robot into the next desired location. Each time the record button is pressed, a point is entered in the memory of the controller. The robot program consists of the ordered set of points. The operator can also specify that the robot is to wait for or generate an external signal before moving to the next recorded point. The teach box also has a playback and speed control so that the operator can play back his program in slow motion and edit it. The controller will move the robot from recorded point to recorded point by generating intermediate points along the path between recorded points. The operator during playback can add additional recorded points if he does not like the controller-generated path.

In figure 7 an operator is shown teaching an Asea robot (servoed). Frequently the servoed robot controllers will allow the operator to record more than one program in the memory. In that case the operator can usually have the robot switch programs based on an external signal. A typical use for this capability is to invoke an error recovery program based on some external event.

Continuous path robots are programmed by having the operator lead the robot through the desired path. In general, these robots are very lightweight and well-balanced, or there is an exact duplicate of the robot used for teaching that has these properties. The program is recorded by having the controller read the joint positions of the robot several times a second and record these in memory. Later on the operator can edit the program to sequence it to external events and add commands to turn the spray gun on or off etc. Figure 8 depicts a painting robot and an operator teaching it a program.

At this point we have defined robots, described their movements, discussed some applications, and talked about how they are programmed. Let me now turn to what the future holds. In so doing I will restrict my remarks to what is currently in the research labs, and capabilities that are recently announced or about to be announced. I will not speculate on the long-term future, such as would be the case for robots that can economically perform household chores.

Let's begin by discussing programming methods. Some current robots already have computers as their controllers, and more will have them in the future. Computers provide the computational power required to replace the tedious and difficult teaching methods currently used with programming languages. Programming languages offer not only an alternative to teach boxes, but the ability to directly link the robot program to the CAD-CAM* data bases which will increasingly exist for many of the parts robots are or will be asked to handle. Unimation has recently produced the PUMA (programmable universal machine for assembly) robot which employs microprocessors at each joint and has a computer controller. Interestingly it has both a teach box and a programming language called VAL. Thus the users can take their choice. Those of you who are familiar with NC (numerical control) machines can think of a robot programming language as an APT for robots. It would appear that robot programmers will require similar training and experience as part programmers on NC tools. In leaving the subject of programming, let me state that robot languages are in the research and development stage, and several alternatives are still being explored.

One of the major drawbacks of current robots is their lack of sensory perception. Don't get the idea that we want to humanize them, rather we need to provide some rudimentary forms of vision and touch to make them more useful. Typically, a robot is programmed to go to a fixed location in space and pick something up. If the object is misplaced by only a small amount the robot will make an error. However, if the robot could see the object, it could adjust itself to small position errors and still complete its task. This is typical of the initial plans for vision systems for robots. Other tasks include recognizing and determining the orientation of parts to be acquired or manipulated. Several research laboratories including my own are actively working on robot vision. Generally the vision system uses a TV camera and computer combination to retrieve the desired visual information.

The use of force and torque sensors is also an important area in the research laboratories. If you imagine the task of mating two parts in an assembly operation you realize how important the feel of the parts in your hand is to proper assembly. Force and torque sensors have the potential to provide robots with a simulated sense of touch, and there is a great deal of interest in this area.

In summary, the current research in robots tends to be in the areas of adding sensors, developing languages, and control systems for robots. While in the space I have it is impossible to give you a complete picture of what is going on in the research laboratories, I hope that you now have a flavor for what is coming.

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*CAD-CAM = *computer aided design, computer aided manufacturing*

Measuring the Effects of Technological Change

Jerome Mark

What do we mean when we talk about changing technology? In the studies done by the Bureau of Labor Statistics, technological change is broadly defined as encompassing significant changes in processing and equipment, products and services produced, and materials, fuels and energy used.

The effect of these technological changes on employment, however, is very difficult to measure. The effects are indirect and diffuse since technological change does not take place in isolation. Technological changes interact with, and are modified by, many other factors that affect employment such as changes in output, demand, consumer tastes, international competition and many others.

Furthermore, the effects of technological change on employment do not necessarily occur only at the plant which introduces the technological change. More often the effects occur through the mechanism of competition and industrial structure, to other plants and industries throughout the economy.

Our experience over the last three decades, however, indicate that as long as the economy is expanding and demand is increasing, steady technological advance is compatible with rising employment.

Between 1948 and 1978, a period of technological change, employment of all persons in the nonfarm business sector of the economy grew by 67 percent from about 44 million in 1950 to 73 million workers in 1978. During this same period, output increased by 163 percent.

Similarly our measures of productivity, which are in part indicators of technological change, show that from 1960 to 1974, for example, productivity went up in every industry for which we publish measures. At the same time, employment grew in almost two-thirds of those.

In many industries, large productivity increases are accompanied by increases in output that require more labor input. This situation occurred in the air transportation and synthetic fiber industries.

Dr. Jerome A. Mark
Assistant Commissioner
U.S. Bureau of Labor Statistics

On the other hand, there have been industries where increases in productivity have been accompanied by a reduction in employment. This was true in the highly mechanized petroleum pipeline industry, as well as in such activities as railroads and agriculture, where employment reductions were associated with strong productivity gains and only moderate increases in output.

The same trend in labor productivity can reflect vastly different trends in employment, depending on the nature of the industry. For instance, between 1960 and 1974, productivity grew over 5 percent a year in telephone communications, railroad transportation, and gas and electric utilities, but each of these industries had a different productivity, output and employment pattern.

High productivity growth in telephone communications was associated with a large increase in output, and the industry experienced a substantial growth in employment.

A similar rate of productivity growth was achieved in railroads with a moderate increase in output and the industry had a large reduction in employment. The rate of productivity increase in gas and electric utilities stayed close to the output growth, and employment barely changed.

Nevertheless, we recognize that technological change can cause job displacement in particular industries. Sometimes the employment impact of technological change is direct as in the case of agriculture. Or, when the industry is concentrated in a particular region or locality, dislocations do occur. In most cases, however, the employment effect is less obvious. Output does not advance at the same rate as productivity in all industries or plants and consequently some industries register employment declines while others register employment increases.

Moreover, the employment impact of a technological change may occur long after the change has taken place and in an entirely different location. When the market for a product is weak, the inefficient, less mechanized plants of competitors may shut down and lay workers off. Thus, directly or indirectly, technological change can cause employment problems in some industries even while jobs in the Nation as a whole are increasing.

Certain conclusions about structural changes in employment, such as occupational patterns associated with technological change, can be drawn. Shifts in the relative importance of employment in the various sectors such as in manufacturing, trade, service, and government have resulted in an occupational structure heavily weighted with white collar jobs.

Whereas in 1950, nonproduction workers accounted for about 18 percent of total employment, in 1978, they accounted for about 28 percent, a 10 percentage point increase, with most of this shift occurring between 1950 and 1970.

According to BLS studies, the dominant trend in our economy during the 1980s will be the continued growth of white collar employment. By 1985, the fastest growing occupational group will be that of managers, officials, and proprietors, increasing 51 percent between 1970 and 1985.

The second fastest growing group will be clerical occupations, followed by professional and technical, and then service jobs. Blue collar workers will be increasing more slowly.

Some different trends are expected in the manufacturing sector of the economy. While white collar jobs will be increasing faster than blue collar jobs in manufacturing, they will not increase as fast as the average for all industries.

The BLS also studies the labor impact of specific new technologies. The computer is a major innovation that we have devoted much study to throughout the economy. When computers were first introduced for office data applications, predictions were made that large numbers of clerical and kindred workers would be displaced, but employment actually increased among clerical and kindred workers by about 73 percent between 1960 and 1978.

Why did this happen? First of all, normal growth of clerical work offset clerical jobs eliminated by the computer. Second, the introduction of computers made possible work that was previously impractical because it would have been too costly or would have

Jerome Mark

taken too long by pre-computer technology.

In addition, the introduction of the computer created job opportunities in new occupations, and created new industries to manufacture computers which created employment for thousands of workers in all types of occupations.

The BLS has also studied the use of the computer to control production processes. This study provides an illustration of how new technologies specifically affect job content, skills, and training. When they were first introduced, process control computers were applied mainly to processes that already had a high degree of control, such as steel making, petroleum refining, chemical and electrical power generation operations. Applications have increased since then, and process computers are now being used by a large number of U.S. industries from the printing industry to the automobile manufacturing industry.

One of the industries we studied was the steel industry, where computers are being used to control basic oxygen furnaces, annealing and tinning lines, hot strip mills, and fuel and utilities networks.

One of the more important findings of our study was that computer control led to an increase in managerial and technical manpower without a decrease in operating manpower. More than half of the new jobs were managerial and professional positions consisting of coordinators of process computers, systems analysts, process engineers and procedures analysts. The remaining new jobs were computer console operators. Most of the employees recruited for the new jobs were selected from among the existing workforce at the plants.

The general procedure at the steel plants was to train engineers in programming techniques for computer process control rather than to hire persons skilled in programming methods from outside the company. Accountants who had experience with business computers were trained in process computer techniques. Some of the computer console operators were staffed from company clerks who applied for and completed a series of aptitude tests.

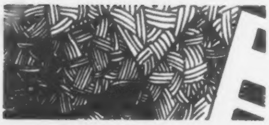
Employees assigned to new computer jobs generally were upgraded in wages and title. The computer console operators, for example, averaged a 22 percent increase in salary.

It is significant that no employees were displaced because of the installation of the process computers. Also, total employment in the affected units comprised only about two percent of the total employment in the plant, so that even if the displacement impact in the affected production unions had been severe, total plant employment would have been relatively unaffected.

Our research indicates that the major impact of computer process control on the employees was to change their job duties. At three steel plants surveyed, a total of 62 persons were in positions that were modified because of computer process control. Of this group, 90 percent were operating employees, and the balance were non-operating employees including supervisors, electronic maintenance workers and recorders.

Job changes among operators generally consisted of a shift from manual to automatic manipulation of dials, levers, and other control devices. Some operators were also trained to operate computer equipment. In the non-operating employee category, supervisors gained responsibility for computer equipment, recorders shifted from manual to automatic data logging and electronic maintenance workers were trained to repair and maintain computer systems.

We did a detailed examination of job changes which involved the operating crew of a computer controlled 80-inch hot strip mill. The mill was operating under computer control for approximately 75 percent of its scheduled production runs and operating under conventional control the remaining 25 percent of the time when visited by BLS personnel. The major advantage of computer control in this installation was the greater speed in turning out uniform products within specifications. Under conventional control, operators required about 2 minutes to make control settings, consulting printed reference tables as a basis for manual adjustment of dials to the varying specifications of incoming slabs.



The computer, however, resets the mill in only 6 to 8 seconds on the basis of specifications stored in the memory unit. During rolling operations under manual control, the speed of the mill was limited by the ability of the operators to react to changing mill conditions. In comparison, the computer reacts almost instantaneously.

Of the 33 positions in the hot strip mill, the duties of nine were modified by computer control while the remaining 24 were unaffected.

There was general agreement among those interviewed that the training program to provide workers with programming maintenance and operating skills was essential for the successful introduction of the process computers. Even in such computer process control operations where workers are not displaced, the technology can require substantial worker adjustments to new job demands and training.

In the printing industry, however, the capability of electronic computers to undertake several key composing room functions traditionally carried out by composing room craftsmen can have considerable impact on the occupational structure of the composing room where compositors and type setters account for 39 percent of the printing trade craftsmen. In fact, between 1978 and 1985, employment of these two trades is projected to decrease very substantially by about 25 percent.

So all industries are experiencing technological change, but the pace of change varies substantially by industry. Each industry has its own story and it is not always in terms of computer technology or advanced automation. Conventional changes, including materials handling mechanization, larger capacity equipment, and machines with faster speeds are often major developments with implications for worker adjustment to new skills.

The occupational structure of the nation's workforce is being upgraded. Skilled technical and professional jobs are increasing at a proportionately greater rate. Employers are putting more emphasis on formal knowledge, precision and perceptual attitudes.

Many menial tasks are being taken over by machinery with unskilled manual workers increasingly becoming monitors of very expensive equipment.

All of this technological change is inevitable, but it doesn't have to mean economic disaster for workers. Advance planning and notice by management, transfer and retraining of workers, and adequate severance provisions are just a few of the mechanisms that can be utilized as absorbers to cushion workers from the impact of technological change.

Productivity: Progress through Cooperation

Frederick L. Haynes

In President Carter's 1978 Economic Report, he pointed out that the slowdown in productivity growth in the U.S. is "one of the most significant economic problems of recent years."

The slowdown of our productivity growth rate, however, is not the only contributor to our problems. Recent trends in technological innovation in U.S. industry are very disturbing. We are investing less in industrial research and development leading to job-creating high technologies. Moreover, regulation of industry has increased to the point where a large part of our industrial research and development is directed toward regulatory compliance rather than marketable products or processes.

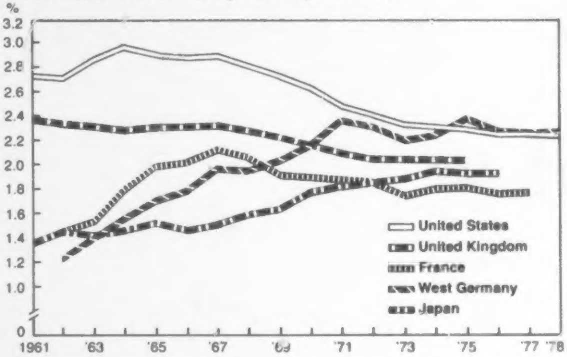
Capital investment in modern plants and equipment is lower here than in any other industrialized countries. The profits of our large successful companies have been used to purchase other existing companies in many cases. Consequently, little capital has been allocated to innovation, and the number of new innovative American companies entering the marketplace has indeed decreased substantially.

The April 9, 1979, issue of *Fortune* magazine pointed out that one of the major obstacles that we face is that of competition with powerful government industry partnerships in other countries. Industry partnerships should embrace—in a focused and cooperative mechanism—the joint collaboration of industry, government, university, and of utmost importance, the labor movement. The article explains that while many of these companies are operating at a loss, they still manage to control world markets because they are so strongly state-supported. How can we possibly expect to compete with these companies if we do not have some kind of strong government support for our own?

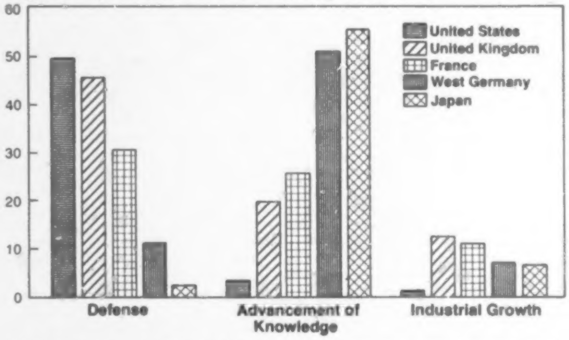
In the past decades, the U.S. was a world leader in the development and export of industrial technologies. Our seed corn has now been planted and is flourishing in other countries of the world. Moreover, new hybrid technologies are being developed and more support is being given to the technology crops in other countries than here in the U.S.

The chart on the trend in expenditures for R&D (Chart 1) demonstrates that the U.S. continues to show a fairly secure position in this area. But when you look behind these statistics to the R&D expenditures broken down into funding by socio-economic objectives (Chart 2), you get quite a different picture. Clearly, the emphasis placed by other countries on technology and industrial growth should indicate to us that something has gone awry in our operations and in our business.

Gross Expenditures for R&D As A Percent of Gross National Product by Country, 1961-78



Public R & D Funding by Three Selected Socio-Economic Objectives, Percent of Total Funding 1975-1976



Moreover, we can readily see the effect of their emphasis by looking at our trade balance. If we divide our manufacturing products into those that are R&D intensive or high technology (Chart 3), we note quite a difference. Obviously, the higher technology products are faring better. What is even more disturbing is that this nation and the labor of this nation has been affected by this adverse balance in the low technology areas since the

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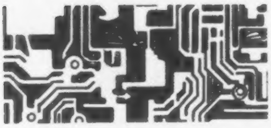
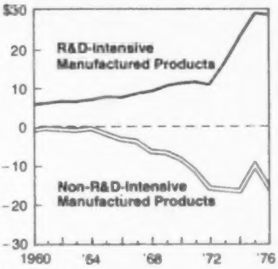


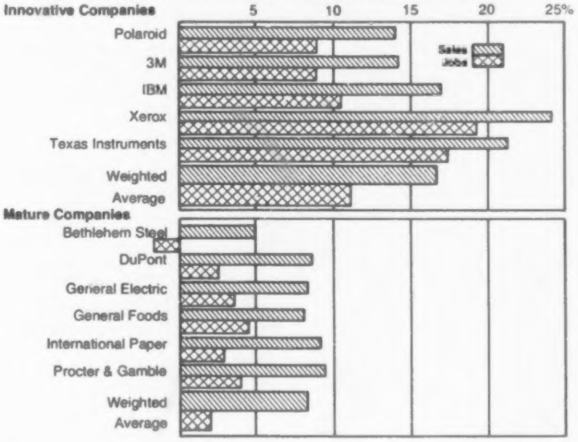
mid-1960s. Who sounded the clarion cry then? Who was looking forward to try and identify an early warning mechanism that would suggest where our problems were going to be?

US Trade Balance¹ in R&D-Intensive and Non-R&D-Intensive Manufactured Product Groups, 1960-76



¹Exports Less Imports

Average Annual Growth Rate (Compounded) 1945-1974



When you compare technologically innovative companies to mature companies in terms of sales and jobs produced, you see that the growth in employment and sales is much greater in the innovative companies (Chart 4). In a recent study by DRI, produced for General Electric Company, we learn that from 1950 to 1974, employment in high technology industry in the U.S. grew almost 9 times as fast as the lower technology indusiries. At the same time prices of the higher technology products rose only one-sixth as fast. In regard to productivity, the output of high technology industries has been growing almost three times as fast as in low technology ones. And the productivity of the individual worker has been increasing twice as fast.

This is nothing new to our competing countries. They recognize the importance of high technology and orchestrate their technological efforts, beginning with a demographic projection. Countries such as Japan, Germany and Sweden, examine demographic data and determine where their workforce is going to come from, who is going to be their major consumer and who is going to have the major amount of money. They then cast this projection into the future and say what kind of gross domestic product do we need to support the population?

They see what kinds of input they will need to support this, and, most importantly, what kind of new innovative technologies they need to bring onboard to not only support the process of manufacture, of turning out new and better goods and services, but also the products.

The key to this is that all of our competing nations have very efficient innovation cycles due to well-spelled-out industrial policies. In the Department of Commerce, we have tried to identify what the U.S. can do to stem this tide and at the same time enhance the growth of our socio-economics system.

In response, we are proposing a cooperative technology program, which labor can have a significant impact in formulating and implementing.

The objective of the program is fivefold. It seeks to spur the generation and use of that scientific and technical knowledge which is essential for industrial development in order to control inflation, strengthen the balance of trade, conserve natural resources, increase employment and alleviate economic dislocations.

Implementation of new technologies at the work place do occasionally, and frequently, provide short-term dislocations. In order to resolve these problems, we need labor's guidance and support.

We must work together if we are to regain our competitive edge. We must learn to establish some cooperative mechanisms to minimize the disruptions in the workplace. We must work together to encourage retraining and generate even more cooperation between us and the universities. We must not be concerned with merely reacting to technological changes. We believe we must work together to make sure they are implemented properly. We have had to learn the hard way that our shortcomings and our shortsightedness will be picked up by our foreign competitors.

Cooperation is the key to success by making the products of American industry competitive with those of our trading partners. If they are not, the U.S. economy loses, our government loses, industry loses, labor loses—we all lose. Then we learn the hard way what it means to be Number Two.

The Economy and Collective Bargaining in the 1980's

Peter Henle

"It was the best of times, it was the worst of times." Charles Dickens' phrasing could well be used as an axiom to describe many periods in the world's history—past, present, and undoubtedly, future.

Forecasting the best of times and the worst of times for the future is particularly perilous in these times, but some conclusions can be reached by projecting present trends, checking on individual industrial developments and meshing prospective changes with respect to the labor force, productivity, output, employment, and needed skills. This is the general method used by the Bureau of Labor Statistics (BLS), and they have come up with some interesting projections for the future.

According to BLS, the labor force will continue to grow, but at a rate that is sharply reduced from the period of the 1970's. For the first five years of the 1980's, the civilian labor force is expected to grow at an annual rate of 1.6 percent, well below the 2.3 percent rate of 1973-77. For the second half of the 1980's, the rate will be even lower—1.1 percent.

There is expected to be a continuing increase in the participation rate for women. That rate, currently about 50 percent, is expected to reach 57 percent by 1990. At the same time, the trend towards earlier retirement for both men and women is expected to continue. Also, a higher proportion of the labor force will be found in part-time jobs.

Total employment, which, for this year will be close to 100 million, is expected to rise to 119 million by 1990. This includes an assumption that unemployment will gradually decline to about five percent in 1983 and down to 4.5 percent by 1990.

The Bureau somewhat surprisingly projects a smaller share of the future labor force to be employed in government. Federal government jobs have been holding steady, with the increase in government jobs coming at the state and local levels due largely to local needs in the fields of education, health, public works, etc.

The Bureau projects a much slower rate of growth for state and local government jobs largely because the needs for jobs in education will decline with the smaller cohort of school age children. Within the private sector, some of the areas of important job gains are the fields of medicine and health, including hospitals, laboratories, nursing services, and nursing homes. Over four million new jobs are expected to be added in private medical care services between 1977 and 1990. This is a gain of 4.5 percent each year.

Another actively growing area will be various business services, including firms that specialize in photocopying, office help, equipment rental, janitorial and other services. Important job gains are also expected in wholesale and retail training, finance, insurance, real estate.

On the other hand, in some industries, jobs are expected to decline, and in many more the growth of jobs will be below average. Actual job declines will occur, or are expected to occur, in the private household sector, agriculture, smaller manufacturing industries including some food and tobacco manufacturing, and also in gas utilities.

On the other hand, many manufacturing industries are expected to get an increase in jobs, but at a reduced rate during the coming decade. In the steel industry, for example, employment is projected to remain steady. It will have no real increase through 1985 and then actually decline slightly for the following five years.

In the auto industry, there will be some employment growth, but at a relatively slow pace, partly as a result of the slowdown in the rate at which the auto buying public is increasing.

The shift toward white collar jobs will continue. This will be somewhat at the expense of the blue collar workers because the other major occupational category, service jobs, will be increasing quite rapidly.

Peter Henle

The trends within the occupational groups are quite interesting. For example, with the computer revolution, jobs like file clerk, key punch operators and typists will be cut out, but at the same time the need will rise for computer operators, repairmen and the like. We expect substantial growth for many clerical occupations with the expansion of firms that service business and those involved in medical and health facilities.

As far as blue collar jobs go, the Bureau projects an increase in nearly all the construction trades, particularly plumbers, structural metal workers, and heavy equipment operators. An even more rapid increase will occur among mechanics who install and maintain or repair computers, office machines and the like.

In manufacturing industries where growth is expected to be slower than average, increases in production worker employment will be limited. In textiles, for example, this slow growth, plus displacement of workers by machinery, will hold down any new employment of spinners, knitters, weavers, and related occupations.

Employment of non-farm laborers is expected to grow. It will not be much of an increase, but the BLS does expect the number of laborers to grow over the next 10 years.

There is little in BLS's projections that suggests unions and employers will have any serious difficulty in coping with technological change. If anything, the changes projected for the next 10 years are more gradual and less disruptive than similar changes that have taken place over the last 30 years. Yet there are some disturbing elements in the future.

The first disturbing element is that the projections indicate a continuing increase in individual and family well-being, but the rate of this increase, according to projections, will be well below the rate achieved in earlier post-war years. This is the result of declining rates of productivity improvement. It is the increased productivity that makes possible an advance in living standards.

When economists talk of productivity improvements, they do not mean greater physical effort by workers but rather greater capital investment, improved technology, a more highly skilled workforce, more efficient methods of work, new plants and machinery, and high growth rates of the more productive industries—all of which contribute to raising the average worker's output per hour.

Peter Henle
Deputy Assistant Secretary for Policy Evaluation and Research
U.S. Department of Labor

The second element of concern in the BLS projections is that they assume an adequate supply of energy with some changes in the mix of fuels used. Higher prices are assumed but not to the degree that the economy's growth would be adversely affected. If, on the other hand, a sustained scarcity of energy should result, the optimistic projections would be out the window.

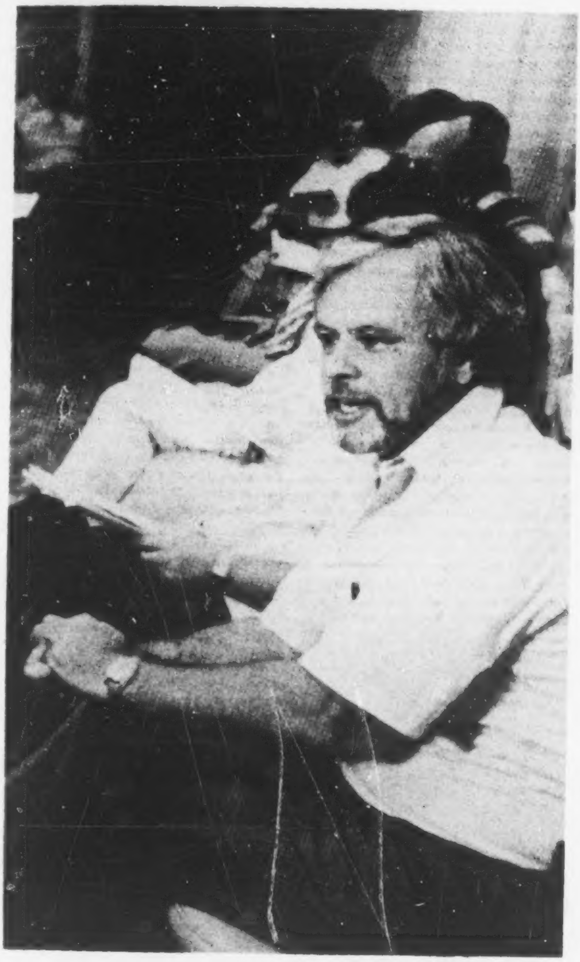
The other element of concern is inflation. The projection is optimistic on the future rate of inflation. The projection does not assume stable prices, but neither does it assume price increases as high as the rate we have experienced in the last six months. For 1981-85, the assumed increase is 5.5 percent and for 1985-90, 4.4 percent. The difficulties that a high rate of inflation pose for the chances for higher living standards are obvious.

These three factors—limited productivity gains, difficulties with energy supplies, and continuing inflation—all of which interact with each other, can easily transform a future which could be "the best of times" into "the worst of times."

Collective bargaining has always been concerned with technological and economic change at the workplace, and it has produced a wide variety of mechanisms to deal with the human aspect of change. Consider the following: advance notice of change, seniority, severance pay, layoff and transfer procedures, relocation allowances, voluntary early retirement, supplementary unemployment benefits, and many others. Not all of these are available in every situation, but unions are able to press for improvements where they feel these are necessary.

Of course, many types of change cannot be handled simply by collective bargaining. The most difficult situation certainly results from plant shutdowns, producing extensive dislocation, particularly in areas where little alternative employment is available. This is a difficult problem involving government policies as well as private programs.

The outlook with regard to productivity, energy and inflation is not optimistic. Because of these factors, everyone in the country, including workers, will find improvements in living standards more difficult to achieve. Nonetheless, collective bargaining as an institution remains strong and should be able to continue to serve well the welfare of workers.



Dr. Ginzberg Comments

I feel a little embarassed to put myself up against the Bureau of Labor Statistics, which is the most responsible long-term place where we produce these data, but I just want to make some statements which may be helpful from an old timer to show you that things aren't quite so simple.

Let me begin by saying that I thought Dr. Mark was absolutely right when he said that there was no simplistic one-to-one relationship between changes in technology and changes in employment. That is, in some places the employment went up because the demand went up still more, and in other places it was kind of neutral. You've got new technology and you maintain the same amount of work, and then in other places you actually had declines.

I think the important point is for the trade union movement to go over some of its own history and try to think whether what you bargained for, let us say in the railroads, was helpful or harmful to you. I don't think you can walk away from a piece of experience like that, because that was a concrete case, and we know what happened. You bargained very well, and you have not got any jobs left. You had better think about that. You have to take some of your own history and work it through because there are no simple answers.

Secondly, I think that, from my point of view, I'm more nervous than Dr. Mark about whether we're going to see continuing increases in clerical workers. I'm worried about the impact of computers and everything else that goes with the new office in terms of clerical work because as I've said before, it's the only place where employers can save any money. That's where the jobs are, and that's where I think they are going to try to save some money, and so I have some doubts.

Thirdly, Dr. Mark and some other speakers called attention to the fact that we are upgrading our labor force. That is, we need more people with more education. I agree, but at the same time, I don't agree. If you read the most recent survey that the Department of Labor, or anyhow, the government paid for out of Michigan, I think you will realize that there are some not very good notes coming back from the work force about people being under-utilized and not having their education used.

That doesn't surprise me in the least, but it's the first time we've heard it and we hear it loud and clear. There is a book that a colleague of mine by the name of Iva Berg did with Marsha Friedman which you might want to look at, called ***Management and the Workplace: A Limited Engagement***. The burden of the book is that a lot of the stuff that we're hearing about humanizing the workplace is not for real, and that management is a very rigid instrument and it doesn't move very well.

Now I have more trouble with Mr. Haynes. I'm older than he is, and he doesn't know that I served in the Department of Commerce in the mid-60s with a very nervous group of people who were convinced that we were losing the race in technology, but, as Peter Henle just told you, we never had it so good—up to the mid-60s. Now what does that mean? It means that in my opinion, you walk around this elephant, and everybody has his own explanation of what's going on in the U.S.

Number one, I'm by no means so sure that our productivity is nearly so bad as it is reported. We don't know what's going on in this whole service sector. We don't know how to measure the inputs or the outputs, and we are now primarily a service economy. So there is something that doesn't look so good in certain parts of our manufacturing, no question about it, but as far as the services go, we don't know what's going on there. So I'm a little suspicious of the total figures about the retardation in productivity.

Secondly, I'm reminded of Mr. Kruschev who used to say in the early-50s he was going to bury us, and I always used to say bury us with what, because he had an economy that was only producing steel and nothing but steel. Now, I know two things about Japan and Germany. They are very far behind our services. So I don't know whether the spectacular productivity gains that they've had has been at the price of what.

They have a disease in Tokyo called "Tokyo asthma". If you ever get stuck there in the middle of the pollution, you will not think that it is the world's greatest country. I don't want to minimize the Japanese but it all balances out at the end.

In any case, I don't think our balance of trade is nearly that bad. I've been having discussions with Mr. Miller, the Chairman of the Federal Reserve Bank, and I don't think our technology is quite that backward. I would say that in an international economy we've got to lose some jobs to get some jobs. You cannot keep everything that you are making in this country—all of the cheap shoes, all of the cheap clothing, and then still expect to sell everything that you have new to the Indonesians or whoever. That's not the way the world economy works.

I am not so sure about the labor stuff that Peter Henle told you because I don't know what is going on with the illegals. There were no illegals in those figures. But from where I sit, I believe there are a million Mexicans coming in a year, and we only get a few of them to go out. We know that we're letting in under special quotas all kinds of people from Asia, and I'm not opposed to this, I'm just telling you that our labor force has the potential to grow and I believe it is growing at this moment faster than the Department of Labor has yet estimated.

I do not believe, from my studies of early retirement, that the inflationary implications have yet been estimated. I am just finishing a study on General Electric and two other major companies, and I was impressed with the fact that one of these companies announced recently that this year it was succeeding in get-

ting almost nobody out with managerial early retirement because of inflation. In short, I think if this inflation keeps up, nobody is going to be able to afford to get out early. So the implications of the size of the labor force must be looked at.

Next, I happen to specialize in medical economics and I don't believe for a minute that we will see the increase in employment in the health field that you are anticipating because I think increases in employment can only come about if you have increases in money. We need to pay for those people. Everything I see in the U.S. tells me that however imperfectly we control the costs on the health front," we will definitely not have a continuing rapid rate of growth in the health field.

As a matter of fact, I see a tremendous shift starting because we've shifted back to the individual to tell him to watch his diet, drinking and smoking and to exercise more if he's concerned about his health. The emphasis is on not getting into a hospital, because once you get in, you've had it. So I don't expect to see big increases in the health field.

Business services, I agree with. I was very impressed with Pete Henle's conclusions because I really would have come out the same way if I were smart enough to say that it is not too disturbing if you look ahead. However, we haven't the faintest idea what we are going to do with three things, namely, getting our productivity up, coping with the energy issue and coping with inflation. With that, I'll leave it to you to figure out how you do all those things.

The Challenges of Technology

Thomas R. Donahue

The problem of people versus machines, and the challenge of seeing to it that the machines serve people is nothing new, but the problems and challenges of technology are once again manifest in the workplace.

This conference strikes me as a demonstration of the maturity of the labor movement. Unlike the sometimes shrill approach of the labor movement toward technological change, when it was called by the buzz word "automation", the tone of the conference and the subject matter you are dealing with here can lead to the consideration of creative adaptation of, and to, technological change both through the collective bargaining process and through other mechanisms and approaches by unions, corporations, governments and citizens.

It apparently was clear to the organizers of this conference that I was an appropriate spokesman for the AFL-CIO. Anyone who showed the foresight which I did in starting out in the labor movement by choosing to work for the Elevator Operators Union, is obviously someone with a firm grip on the future and a clear and demonstrated ability to look ahead and plan and act accordingly.

I remember in the early 50s going to a demonstration by Otis or Westinghouse of their automatic elevator control system. We had a primitive "self-service" elevator for many years but they were of limited utility, but the earliest electronic developments made possible the perfection of a "balance system" which could make a bank of elevators respond to varying patterns of traffic. I remember well seeing this scale model with little rays of light representing passengers filing into the elevator cab until a time sequence or a weight-achievement activated the car. And I watched as it rose and fell, appropriately alternating floors, or skipping floors, speeding up or slowing—and nudging passengers out of doorways.

It was a very interesting toy and the five or six other business agents I was with—all seasoned veterans of the elevator business, all old operators or starters—watched with great interest and agreed "it'll never work"—"can't make any time"—"can't handle a crowd"—"won't be able to empty a building at 5 p.m. rush"—and I, from the depth of my two part-time years as a department store elevator operator was smugly confident it could never answer the question about what floor lingerie was on or announce floors, clear the doors, or whatever.

We all went and had coffee and marvelled at modern science, which in the next 10 years wiped out over 15,000 elevator operator jobs, or caused them not to be created, in New York City alone. We scrambled to slow it down a little, phase it in, transfer workers, negotiate early retirement benefits, enlarge severance pay, optional choices for the most senior workers, creation of new jobs and job titles, such as Lobby Attendants and Information Directors. We merged departmental seniority lists, and trained ex-elevator operators as porters, handymen and superintendents and negotiated the highest wages and fringes in the U.S. for the reduced workforce.

So, in a much less sophisticated era, I learned about technology and its wonders, and I learned about its effects. I learned about the inevitability of technological change and about the need for our unions to deal with it.

As trade unionists, our concern must be people and what this new technology does *to* people. I emphasize, "What it does *to* people", because the scientific community has more than enough resources to remind us what technology does *for* people.

Surely there are countless benefits of technology—benefits which can be shared by all. Assuring that all share in these benefits is a responsibility of the labor movement. It is a responsibility we shall not meet, however, by posturing ourselves like ostriches—with our heads in the sand until the last moment.

At the same time, it is incumbent upon us to point out the dangers of technology and its impact upon workers. What has technology brought us?

It has brought us about 1,100 known carcinogens in the workplace. New ways for workers to die from the benefits of new technology. Approximately *600* new chemicals are introduced each year, many with harmful side effects for the workers who produce them and the consumers who use them.

Technology has brought us the new health hazards of stress and stress-related illnesses unheard of during previous industrial revolutions. Amazingly little is known about stress. For all that is written about Lordstown and the "rebellion" of younger workers against assembly line speedups—as if the young were discovering something their parents didn't know existed in the industrial world—scant attention was paid to the stress factor.

Thomas R. Donahue

Similarly, much of the literature on stress relates it to middle managers—the stress of success, the workaholic syndrome, etc.—and little if any is devoted to white and blue collar workers, for example, the forced overtime in a leisure society which creates stress on families.

Increased reliance on professional managers as supervisors—rather than the more traditional approach of training supervisors from the ranks of the workforce—means that frontline management often views workers as machines, because the supervisors lack work experience. The stopwatch mentality replaces reasons; absence control programs replace interesting work; and Muzak is piped in to soothe the blue collar blues. The sum is pressure, stress.

Technology has meant a misallocation of the workforce, with resultant morale problems on the job and a growing disaffection for work. According to a recent survey, an alarming 32 percent of the 1515 workers surveyed considered themselves overeducated for their work. And 36 percent believed their skills are "underutilized." These figures ac-

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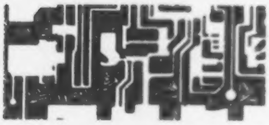

company the first significant decline in job satisfaction in 30 years. This means that human talents and resources are being wasted.

The figures are not surprising when you consider that the number of college graduates in the workforce now totals one-quarter of the total labor force. In 1940, college graduates were comparatively rare in the labor force—in fact, the ratio was one college graduate for every 22 workers. "Train people for the new technology", society is told, and we train, train, train. But when the training is done, the jobs are gone or the skills needed are replaced by a machine

Concomitant with technological change has been the transformation of the U.S. economy from a production base to a service base. Where formerly we had thought of technological change as having its major impact on manufacturing, it is in the service economy where such change is likely to accelerate in the near future.

The implications of such a transformation are frightening, especially when you contemplate who—or what—will produce the goods we will sell each other. Or when you consider that so much attention and effort to ease the impact of technological change is directed at the manufacturing sector. Currently, attention on manufacturing dominates despite the fact there are many more workers in the service sector. And the service sector, even with its omnipresent computer, is largely untouched by technological change. The adjustment facing these service workers is likely to be more abrupt and more harsh than in the industrial sector, which can look back on past experience with automation.

Oh, yes, there are the giggles: the robot internal mail delivery system, which replaces the young man or woman pushing the mail cart. There are machines capable of typing a letter from the spoken word and reproducing it in vast quantities, addressing, folding and stuffing envelopes and affixing postage—without a human hand. On Capitol Hill, there are computers to answer letters from pre-written paragraphs.

But the laughing stops when the people these machines replace reach the unemployment line. By that time, of course, it is too late—save for palliatives, such as unemployment insurance. The time is now—for trade unionists, for government, for industry—to develop a strategy for dealing with technological change in a creative manner that minimizes injury, and maximizes the accommodation of technology to people, and people to technology, while providing the benefits of technological advances to a better world for all people.

The creative tool which we in labor bring to this process is collective bargaining. Through negotiation, employers and employees can develop those approaches that humanize both the workplace and the work itself, including the impact of innovation and new technology on workers' jobs, earnings and futures.

If employers are willing to sit down with the unions representing their employees, then they will find a partner. If employers recognize that the labor movement does not oppose technology, but that we oppose throwing people on a scrapheap, they will find understanding. If employers are frank and open and willing to listen, they will hear ideas—not bombast.

But if employers refuse to view worker adjustment costs as part of the cost of industrial innovation—the human cost, if you will—they will find resistance. This resistance may only delay the inevitable, but the price in bitterness and confrontation is likely to be costly.

I hope employers will sit down, because there is a lot to talk about.

One method to ease the human costs of industrial innovation is to assure advance information to workers and their unions about management plans for future innovation which will affect workers with job loss or other serious problems.

Major innovations result from management decisions taken long before the innovation is actually introduced. The recent shutdown of the Youngstown, Ohio, steel plant involved corporate decisions made years earlier. Certainly there should be long advance notice before any innovation or technological change which results in layoffs or plant shutdown, or even in less serious disarrangement or rearrangement of people and of functions.

An "early warning system" of advance notice makes it possible to begin to meet the problems of affected workers. Such "early warning" provisions have long been standard in many union contracts. With advance notice and labor-management cooperation, workers can look for or train for a new job, perhaps with the same employer in the same plant or at another location. Employer-paid retraining is an important part of any adjustment-to-innovation program.

There are other methods and techniques for labor-management cooperation to cushion adverse effects from industrial innovation and changing technology. These include income maintenance with work and/or pay guarantees.

One way is through "no-layoff" attrition to reduce the workforce by natural turnover, deaths, retirements, and voluntary quits, thus protecting the jobs and earnings of those workers who remain with the company. Of course, attrition alone is not an adequate solution. "Red circle" earnings protection for workers downgraded through no fault of their own attaches a wage rate to an individual instead of to the job itself, and thus protects workers against loss of income which might result from innovation-induced downgrading.

Seniority is a key principle in protecting workers against layoffs and downgradings. Early retirement is an option that older workers should have available when innovation or major technological change wipes out their jobs. But the option should be available as a free choice, not as a requirement.

Transfer and relocation rights and mobility assistance to workers are other ways to provide job and income protection. Within-plant and inter-plant transfers, relocation assistance, severance pay, pension rights and seniority protections and supplemental unemployment benefits can all help cushion adverse effects on workers and their families when industrial innovation occurs.

More information is needed on the effects of industrial innovation and new technology on workers. Federal action is needed to set up a clearinghouse to gather information on a

continuing basis on innovation and technological change and its effects on the welfare of the American people, on jobs, skills, training needs and industry location. With more and better information, public and private adjustment programs can better avoid needless human hardship and suffering which too often result from the disruptive impact of changing technology and innovation.

Through this clearinghouse, the federal government could provide unions and employers with comprehensive information and service, upon request, to help the parties develop labor-management solutions from the complex problems related to the impact of innovation and technological change at the workplace.

Innovation-caused economic dislocation and other kinds of dislocation— including plant shutdowns caused by technology change, job loss from trade policies and production shifts away from defense-related industry— require cooperative labor-management efforts and also national programs to deal with these complex problems. Further exploration is needed of a variety of such programs, including proposals dealing with plant shutdowns and plant relocation and with reconversion of defense-related industry.

We need to know more about and to monitor assiduously the export of technology. It may well be that our technology will be our most important asset, our most important strength. We as a nation ought to take a serious look at the indiscriminate and unnecessary transfer of that technology abroad, most often by the multi-national corporations for reasons of profit alone. We need to develop a measure of the desirability of such transfers from the standpoint of our traditional well-being, in terms of its effects not on profits, but on jobs and its effects on the American people and their communities.

Let me note that in the larger sense, not alone in terms of technology-induced change, but in terms of all change and growth in America's corporations, I would also like to see the measurement of success or non-success of those corporations made on the same bases—that is, to say, I think it's time that America's corporations are judged not on their bottom-line profit figures alone—but rather on their responsibility toward their workers and the communities in which they operate. Why can't we say the XYZ Corporation had a bad year in 1978 because it ended the year with fewer employees than the year before, that it provided a livelihood to fewer people than the year before—why can't we say the Apex Corporation had a bad year because it ended the year having closed its plant in Akron or Columbus and left 200 or 300 workers without jobs. That's surely a greater failure than a drop of 1¢ or 2¢ in the dividends for that year. Until we get those kind of social measures, and until we teach Americans to measure our corporations in that fashion—we won't solve the question of adjusting to new technology or even of adjusting to the age-old problem of greed.

National full employment programs must assure an economic climate in which collective bargaining can flourish. These national programs must help solve the social and human adjustment problems, created by innovation and new technology, which lie outside the scope of collective bargaining.

If the economy is healthy and expanding, new work opportunities will develop and the benefits of technology can be enjoyed by all. Indeed, with full employment, business would be encouraged to innovate, to introduce new technology, since there would be a market for their products.

In the absence of full employment, however, rapid and thoughtless technological change can only exacerbate social problems, especially through the displacement of workers—particularly minorities and women who are just beginning to achieve job levels which permit them to enjoy the benefits of technology.

But when we've said that, we must concentrate our attention on people and accommodating technology to people and making it serve people. When we've looked at its dangers and the need to develop a strategy to deal with its inexorable growth—we've only dealt with our fears and our concerns for its negative potential. The potential for using technology to truly improve the quality of work-life, to make work processes more interesting (not less), to make work more challenging and more satisfying (not less) is immense. The potential for using technology to reduce the work week, to enhance our educational and self-development opportunities, to enlarge our interest horizons, to improve the opportunity to enhance the human spirit, is immense.

The potential for misusing technology is equally immense.

Clearly, technology is itself neutral and the only question before the house is how we put it to use. If applied badly, it's a savage beast. If we put it to use with a meanness of spirit, an intent to enlarge profits, to further enrich those already abundantly well off, we'll suffer its consequences.

If we apply it with a soaring spirit, if we see it as making possible the enrichment not of the few but of the many, as creating the opportunities finally to help the least, the left-out and the lost, then people will be able to look back in 50 years and say we did well.

The labor movement can—and must—be a force in the process of technological change. If we are not partners in resolving the problems which will undeniably face workers, regardless of the color of their collar, then "human error" will be eliminated and the glorification of the machine shall be complete.

Technology, Telephones—and Jobs

Glenn E. Watts

Perhaps the Communications Workers of America is one of the clearest examples we have in the way automation and new technology reshapes the workplace. The CWA literally had its beginnings in the Bell Telephone System which is one of the prime examples we could use to discuss this problem.

The Bell Telephone System represents an industry where the dial telephone system soon became the symbol of all that automation would mean to the lives of literally hundreds of thousands of men and women workers. The dial telephone has been around for more than 50 years, and to those of us who were conscious of what was going on at the work place prior to the 1930s, it was a relatively new and exciting device.

It did not begin to be introduced broadly in the United States until the end of World War II when there was almost a crash program in the direction of introducing the dial telephone. Those who think of new technology as the death of jobs might get a special jolt out of the fact that the first workable dial telephone was invented by an undertaker—an embalmer by trade, in the year 1891.

Five years later, the first dial telephones were placed in service in the city of Milwaukee, Wisconsin, which has the distinction of being closely allied with the first telephone exchange and the first really economically viable telephone company ever to be functioning in the United States.

It should be noted, though, that the dial phone was a slow starter in the U.S., even though it was more widely used in Europe before it was in the U.S. But once it started moving, it became almost the irresistable force and is generally conceded to be the first widespread application of the forerunner of automation—border to border, and coast to coast, as well as around the world.

In CWA, then known as the National Federation of Telephone Workers, the NFTW, we saw it first as a threat to job security, which it certainly was. Telephone operators comprised half the telephone work force in the 1940s, when we began to grapple with this subject in a major way. Today, telephone operators comprise no more than 25 percent of the work force in the telephone industry.

By the middle of the 40s, we were negotiating protective clauses in our contracts where we could get them agreed to, under the heading of technological change, even though real technology was not yet on the scene. And with the establishment of a dial conversion committee, established within our union in 1948, the first authoritative study was done on what was happening, not only to operators but to all employees as a result of these mechanical changes, and we felt we were on our way to a real understanding of the problem.

As a matter of fact, we did come to a fuller understanding of what was happening, both to people and to jobs, but our basic attitude remained optimistic. Automation, we said, could be a boon, not a curse, if sufficient planning was devoted to its introduction.

Although we saw problems on the horizon, it was possible for us to conclude in the late 1950s, "To date, we think any reasonable person must conclude that automation and its predecessor mechanization have enriched all segments of American life including the average worker. In fact, the introduction of the assembly line and other mechanical processes help make possible mass production of goods at prices workers could afford, and played a great part in contributing to the dynamic growth of the entire American economy and a high standard of living.

"Today, after more than half a century of industrial revolution, the American economy is able to support more workers with a higher standard of living than ever before in history. For ourselves, we welcome automation because we see in it a lever for higher wages, longer vacations, shorter hours, and ultimately greater seniority for ourselves and the American people."

We boiled that all down to a phrase that we continue to use saying, "We welcome automation, BUT . . ." We put the word "BUT" in caps, and by that we meant we insisted that a fair share of the distribution of the increased wealth as a result of the increased productivity from mechanization and automation be shared with the workers, and not just go to the maximization of profit by industry.

At the same time, we were pushing for union management cooperation to solve the problems that were emerging. Our goals included: a shorter workday, and a shorter workweek for all workers; improved force reduction and hiring procedures; interdepartmental and intercompany transfers including payment of transfer expenses; higher pensions and lower optional retirement age; more liberal termination payments for those who lost their jobs as a result of technological changes; better and more extensive job training programs and improved seniority arrangements.

We're still working on those goals. Meanwhile, a great deal more than dial conversion has taken place. Direct long distance dialing came on top of incredible improvements in cable, microwave transmission, EDP billing, electronic switching and computers. In fact, the telephone system became, and is today, just one big computer.

If you think about the telephone operator in earlier days and recognize the drastic decline in operator jobs that resulted from the elimination of the old cord switchboard by the computerized system called traffic service positions, TSP's, you will begin to realize what really has happened.

In 1977, operator jobs declined by 10,500 positions in that one year. The number of operators in the Bell System alone has gone from 213,000 in 1960 to only 114,500 today, yet there are more workers in that same company or industry today than there were in 1960.

Another major technological development is the electronic switching system, ESS. This system brings computerized program control to the job of switching a telephone call in what we call a central office. In terms of employment, the ESS equipment requires less than half the non-management personnel to operate and maintain a traditional switching office. It has not reduced the number of management personnel. During that period of time, approximately 636 positions have already been eliminated by the number of ESS transitions that have taken place.

We at CWA are also keenly aware of the development and deployment of fiber optics, literally, a light emitting dial. The hair-thin strands of glass carry communications by means of a series of light impulses and will ultimately make use of the laser beam. This

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could have enormous effects on the position of cable technicians in related crafts, but we have no projection at the moment as to how it will affect the ultimate size of the work force.

Yet we can look back on one other development in the same area when lead cables began to be replaced by polyethelyne covered, or plastic covered cable. When the industry introduced that kind of technology, productivity was increased by a phenomenal rate for that particular job position—as much as 1000 percent because of the techniques required to do the work. When it was introduced, rather than being satisfied in terms of maximizing profits by this very large increase in productivity, the industry insisted on giving the work to linemen instead of splicers, whose rate of pay was substantially lower. We fought that battle for 15 years, and ultimately lost it. I foresee another battle of that kind with the introduction of fiber optics.

The trend towards encouraging the peripheral operations of technology, such as encouraging housing contractors to install telephone connecting and wiring apparatus as a part of the entire building process while the buildings are being built by tradespeople other than telephone technicians, affected the job of the telephone installer. As you can imagine, jurisdictional problems began to arise as a result of that. A general decline of three percent in this type of job classification is anticipated between now and 1985 by this job redesign alone.

The CWA must frequently cope with the technological developments of the industry, AT&T in particular. Clearly, the introduction of technology will continue to take its toll in our industry, and our union has done some things along the way to try to cope with all of this.

Our union has attempted to soften the blow somewhat for our membership. In the last round of negotiations, 1977 with the Bell System, we bargained for a supplementary income protection plan. We call it SIPP. Some people says it's just a sip because it's so small in terms of its protection. And we also introduced in that round of negotiations a reassignment paid protection plan.

Glenn Watts

The SIPP applies to employees who are eligible for retirement, provided they are under the age of 62, and by and large you can retire about the age of 50 in our industry. Retirement benefits, though, are reduced substantially if you retire early. Affected employees, those who would be affected by the introduction of technology, have the choice under some circumstances, of accepting a transfer to where there might be another job opening, perhaps at the same job level or at a lower one, rarely at a higher rated job; layoffs with some kind of termination allowances that we've negotiated; or even a down grade to a lower rated job, or they can retire on a pension—the reduced pension plus this SIPP benefit. The choice is made in order of seniority.

SIPP benefits will generally be limited to three dollars per year of service plus 40 percent of the basic weekly wage, up to a maximum of $250 per month. Benefits are in effect for a maximum of four years, or until the age of 62, at which time social security plugs in and a regular pension would become effective. At that point, those benefits replace SIPP and the earlier retirement benefit itself.

The reassignment paid protection plan applies to an employee who is reassigned downward through a force adjustment. His or her pay would be reduced but not all at one time, and would be reduced based upon length of service and in accordance with a time schedule over a time span. Employees, as an example, with anywhere from no service to 10 years of service, would not feel the full impact of a pay reduction for 13 weeks and an employee with 15 or more years of service would not realize the full reduction until the end of 65 weeks.

One of the things that we had in mind in that is that we hoped during that period of time we would be negotiating general wage increases which would tend to maintain the earlier level of wage, and in some cases, it would actually permit an employee to have the same wages even though the job that they had transferred to was at a lower wage rate in the scheme of things.

Technology often affects the kinds of skills or the degree of skills needed. Even if the number of jobs is not changed, or if the number of jobs is actually increased, we face the task of bargaining with the employer to advance or upgrade the level of compensation for these enhanced positions, and frankly, this is not an easy task.

We've been successful in securing a certain short-term solution for coping with technology. It is our hope that we can succeed in finding and implementing a reasonable and effective long-term solution that will protect workers from the adverse effects of technological change, while at the same time recognizing the ongoing need for the introduction of technology in order to have an overall increase in productivity within society so that we can have an ever-increasing standard of living.

Yet today, in view of what is occurring as far as technology is concerned, that objective may be automatically converted to one of attempting to retain the standard of living. That is to say, not permit the standard of living to be pushed down.

The old problems are still with us. I think you will find that demonstrated by the kinds of things that we were talking about 30 and 40 years ago when we were talking about simple mechanization. And I suggest that the problems will be with us 20 years from now, but on a different scale.

Bargaining for Change on the Railroads

You can't talk about the railroad industry today without talking about technological change. I'm happy to see that this conference has recognized that trade unionists can't come to terms with the impact of technological change on the workplace in general, without talking about the experience of the railroad industry in particular.

Railroads, of course, are an outgrowth of one of the greatest technological breakthroughs of the past 200 years—the invention of the steam engine. For the past 100 years or so, since railroad workers began organizing themselves into unions, technological change has been an ever present issue for us. The emphasis has not always been the same, however.

In the early years, rail unions fought *for* technological change. Work was dangerous. Conditions were harsh. Anything that would improve things was welcome.

It wasn't until after World War I that this commitment to technological "progress" started to wane. Not because all the dangers and harshness of the workplace were gone—they weren't—but because each new technological change combined with changes in operation or organization to bring new threats to the security of our members' employment.

It wasn't until after World War II, however, that unions in the rail industry started fighting *against* technological change, or, more properly, started fighting against its adverse effects.

Since the 1920s, such changes in the form of a new machine here or a new technique there, had been constantly chipping away at jobs, but next to the impact of the Great Depression its effect seemed minor. In 1929, there were 1.6 million workers employed in the railroad industry. In 1939, there were only 987,943. Throughout that decade of employment crisis, our unions were less concerned with the causes of decline than we were with stopping it.

Some significant breakthroughs were made in this regard, such as the nation's first employee protection agreement signed in Washington in 1936. But it was the war itself which turned the industry around and brought employment levels back up to a 1944 peak of 1.4 million.

Once the war was over, however, the numbers began to drop again and have continued to do so ever since.

By 1955, employment was down to just over 1 million.

By 1965 it was down to just under 640,000.

By 1975 it was down to 494,000. And last year, it was down to 491,251.

In just 35 years, then, employment has dropped 65 percent—the greatest post-war decline of any major industry in the country. The decline is attributable in large part to the effects of technological change—both within the industry itself as well as outside it.

Internally, the changes have been many:

- The diesel was introduced to replace the steam engine. Because it could travel longer distances and required less service, jobs were cut.

- Sophisticated machines for track maintenance were introduced. They allowed a gang of 15 to 30 men to do the work once done by gangs of 100 to 300 men.

- Automated, centralized traffic control centers were established. They made the work of thousands of telegraphers, operators and others involved in communications, redundant.

- Warehouses and loading operations were mechanized. The strong backs of freight handlers were needed less and less.

- And, of course, the computer was introduced in 1956. Perhaps more than any other single innovation—including the diesel—it has changed the quantity and quality of the rail industry's workforce. In just 23 years, it has forced the phaseout of many old clerical jobs and led to the introduction of new jobs to do the same work that are fewer in number but which require more highly skilled workers.

In addition to these internal developments, the impact of technological change in competing modes of transportation has also come into play:

- Before World War II, the railroads accounted for 75 percent of all inter-city passenger travel. With the post-war growth in popularity of the automobile, this declined rapidly until today we carry less than 8 percent of all such traffic, while cars carry 85 percent.

- The Rail's advantage in freight traffic has also declined in favor of the trucking industry. While the actual volume of freight moved by rail has increased, our share of the freight market has dropped. In 1929, for example, rail moved 70 percent of the freight in this country. Today, our share is around 40 percent.

- Improvement in air, water and pipeline transport has further weakened the competitive edge of the railroads.

The impact of these developments outside the industry has contributed to mergers, cutbacks in service, and in some cases, bankruptcies. And as with those developments within the industry—many of which have been introduced as a means to improve efficiency with a view to improving the industry's competitive edge—they all have the same negative impact on employment levels.

Needless to say, they have had a negative effect on industrial relations on the railroads, too. They have often been at the heart of some of our toughest fights at the bargaining table where we have held fast to the position that the cost of any change that aims to benefit a company, an industry, the economy or society as a whole, should not be borne by that particular group of employees which is most directly vulnerable to such a change.

In other words, we do not oppose technological, operational or organizational changes per se. We just want to ensure the adequate protection of adversely affected employees.

Fred J. Kroll, *President*
Brotherhood of Railway, Airline and
Steamship Clerks, AFL-CIO

While justice has always been on our side in this struggle, it took us many long years to convince the carriers of that. In fact it wasn't until 1961 that BRAC concluded its first protective agreement that spoke directly to the issue of technological change. Ironically, that agreement was with the Norfolk and Western Railway which is the same carrier we struck for 82 days last year on a series of issues that centered on employee protection. That first agreement promised to protect BRAC members adversely affected by company moves to substitute "electronic or electrically operated data processing machines for other types of mechanical procedures and/or manual clerical work" then being performed by those members.

The N&W agreement was one of many that were reached in the early 1960's by BRAC as well as other rail unions. They all had similar objectives. They sought to ensure that

- employees be notified of pending changes;

- unions be consulted to help minimize adverse effects;

- cutbacks be covered through national attrition to the extent possible;

- the more senior employees be guaranteed options to enable them to remain employed; and

- displaced employees be provided benefits, including moving expenses and the maintenance of fringe benefits.

In the years since, we have sought to improve provisions in our protective agreements to the fullest extent possible. We have further tried to create more job opportunities by improving vacation provisions, introducing personal leave days and negotiating better opportunities for early retirement. We have tried to ensure that current employees have the first opportunity to retraining on new jobs that may have been created to cover the work of cancelled jobs. And we have tried to ensure that work that has been covered by our agreement remains covered by our agreement, even though it may be changed from a clerical procedure to a computerized one. This has been an area of constant trouble for us as witnessed by our strike last year on the N&W.

Fred J. Kroll

Over a period of time, more and more work was being transferred out of our bargaining unit by the carrier and assigned to non-union positions that, all too often, were filled by friends and relatives of management. The burning resentment our people felt for such practices was reflected in the militancy and endurance they showed through 82 long days of strike. The issues weren't supposed to be strike issues but they were. Clerks weren't supposed to be so tough. But we were. And we won.

Even short of such a strike, it's always a struggle to hold on to our work as more and more functions our people have always performed are computerized, but we've got to in order to ensure our people have an opportunity for continued employment, as well as to ensure our security as a union.

To date, we have been successful in our efforts to these ends. But like most challenges we face in the labor movement, it's one we've got to meet every morning knowing full well that yesterday's victories don't mean anything if we lose today.

The Effects of Changing Technology in Printing

William A. Schroeder

Technological change has always been with us. Ever since man has been on this earth, there has been change—and constant change—but the difference in recent years has been the constantly increasing rate of such change. The big problem confronting us today is the fantastic rate of scientific and technological change that is occurring in virtually every facet of our lives.

In the past, workers entered an industry with the assurance that the industry would remain somewhat the same and that they were more or less embarking upon a lifetime career. Workers entering apprenticeships were advised by their parents, their co-workers, and the journeymen who taught them that the knowledge they were gaining would serve them for a lifetime. Such is no longer the case. Change is constant and exceedingly rapid, so much so that workers must accept the philosophy that it will be necessary to constantly upgrade their skills and periodically retrain in related areas, in order to earn a livelihood.

Before going any further, I had best acquaint you, to a greater degree, with the graphic arts industry. In the United States, the graphic arts industry employs more than 1,100,000 workers and has annual sales of more than $52 billion. Of all the manufacturing industries in the country, the graphic arts ranks first in the number of establishments. There are more than 40,000 individual establishments spread across the United States. This industry ranks 7th in the value of receipts; it ranks 8th in terms of total employment; ranks 9th in terms of production workers, and 13th in terms of expenditures for new plants and equipment.

Of the aforementioned 40,000 individual establishments, only 5% have 100 or more employees; 80% have fewer than 20 employees. It is safe to say that 10% of the plants do 90% of all of the graphic arts production in the nation. Our industry is segmented and widely dispersed.

The Graphic Arts International Union has never attempted to reject the technological advancements available to the industry. Instead, the union has developed an Education, Training and Retraining Program through which programs have been established in more than sixty cities, where apprentices receive related training and journeymen are up-graded or are being retrained for jobs in other areas of the industry when their former jobs have become outmoded.

In addition, the Graphic Arts International Union has established an early retirement program, which enables workers to retire at age 60, if they so desire. In many cases that decision may be prompted by the changing technology and where the worker no longer has the desire to make that change. The program provides a benefit approximately the same as the worker would receive from Social Security at age 65. In addition, the worker may receive the benefits of any other pension program under which he is covered. The union has three other retirement programs: the Inter-Local Pension Fund, the Photoengravers Pension, and the Graphic Arts Industry Joint Pension Trust. Also, many individual companies in the graphic arts industry have pension programs.

As great as our effort has been to cope with this changing technology, we recognize reflected effects that few people think about or discuss. These reflected effects actually change the structure of industry from the point of ownership, management and geographical distribution. The new technology has made some of the graphic arts equipment tremendously expensive and beyond the reach of many of the privately-owned companies. As an example, in the Preparatory Department, where color separations are made for all of the beautiful four-color process work that you see in magazines, catalogs, brochures, etc., the work was done by craftsmen and required many hours of labor. A magazine cover or a full-page ad in the period immediately after World War II would require about 40 hours of "dot etching" time. It also required a minimum of six hours of camera time. Today, that same job can be done in *seven minutes*, with electronic color scanners.

You will be surprised to learn that there are approximately as many dot etchers today as there were immediately after World War II, as a result of the tremendous expansion in the use of color in printing.

This electronic equipment costs approximately $500,000, and in my discussions with the manufacturers of such equipment, they have advised me that new advanced technology will bring the next generation of scanners to more than $750,000, and by the early '80's, it will be over $1 million. Of course, these new generations of electronic color scanners will be more efficient and will make plants so equipped far more competitive. The investment necessary for a web offset press that would enable a plant to compete in the national market is more than $2,000,000.

It is easy to understand that the small plants, privately owned, cannot consider the purchase of such extremely expensive equipment. As a result, there are more mergers, closings, and sales of operations to corporations, multi-national corporations and conglomerates. Many of the corporations that purchase printing plants have an original interest outside of the graphic arts industry. You may recognize some of the names of corporations that have considerable investments in the graphic arts industry: Mobil Oil, Gulf Oil, Pet Foods, Beatrice Foods, American Standard Plumbing, and a whole line of others, which have changed the entire complexion of our industry.

Many have plants located in different states, and those with plants in the traditional highly industrialized areas have either moved them to the Sun Belt or have opened branch

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William A. Schroeder, *Vice President*
Graphic Arts International Union, AFL-CIO

plants in either rural areas or in the South. All of this presents a tremendous challenge to organized labor.

We all recognize the rising tide of anti-unionism that confronts us at the present time. In great part, this current surge comes from the corporate desire to destroy every segment of organized labor. They have the money and the strength to promote their anti-union philosophy. Labor unions have difficulty organizing plants than can be shut down at will by a corporation that will move the work to another of their plants located hundreds or even thousands of miles away.

The worker can no longer rely upon the National Labor Relations Board as the protector of their right to be represented by a labor union when the corporations have learned to use the loopholes, and skirt the fringes of the law through the use of union-busting attorneys, and thus frustrate the will of the people.

The collective bargaining process, which has been the basis of the organized workers' gains in the past, is in jeopardy. We are constantly bombarded with right-to-work law promotion, and movements for a union-free environment. A great effort was made for Labor Law Reform and we failed. We must continue our efforts if working people are to gain the full benefits of changing technology. Obviously, it will be necessary to have greater cooperation between all unions and all working people.

William Schroeder

John Stagg

Exporting Technology Means Exporting Jobs

Elizabeth Jager

Technology means the application of science—not the science itself, but the application. It's the ability to apply new inventions and produce new products, and in an economic system, this technology involves labor. It involves skilled labor, unskilled labor, professionals and scientists.

Managers have to have new technology if they are going to cope with what is going on, and the economists need new technology. I suspect that one of our greatest problems is that our so-called skilled people in the social sciences may, in fact, be technologically obsolete.

In business and legal discussions, however, technology is often identified as the final process, the new invention, the robot, the chip, the dial system, the event, and the practice that has such an enormous immediate effect on labor.

But when we talk about technology in the trade unions, we are talking about both kinds of technology. We are talking about the application of science and the scientific invention itself, because both have an enormous impact on what we are doing. We have no real measure of this impact.

Now, unlike technology, productivity can be measured roughly by economists. I mention this because I gather that you have been told that we are losing out in productivity, and that the U.S. is falling behind everyone else. I don't know what the future of American productivity is, but I think it is important that we put on the record that the U.S. started with a higher base in productivity than most other countries. By most measures the U.S. is still the most productive country in the world, certainly in manufacturing. Even Japan, overall, has only 60% of U.S. productivity. Within the last year, the U.S. has increased its productivity by about 4.2 percent, from the first quarter of 1978 to the first quarter of 1979. So we are not really on our last legs, and we haven't really lost our ability to improve.

I also understand that you have been told that the British unions did Britain in, and the Japanese have solved everything because they have had a better system. There are a lot of people who debate that historical development. Whenever anyone talks to you about Japan, always mention the fact that Japan has had the most protectionist and the most protected economy in the world. But add that Japan has a remarkable economy with remarkable productivity and technological development. The reason for that technological development is because its intelligent government and its people designed their economy so that they could have it. One of the mechanisms to achieve it was that they did have protection against imports that would disrupt their economy, and protection against unrestrained export of their technology.

The Japanese are remarkable people who have done very well. But I think that the Americans should stop putting themselves down because we have provided most of the world's technology over the last 30 years in one way or another.

The AFL-CIO began to complain about this not too many years ago, and we were roundly castigated by all of the experts as being a bunch of stupid isolationist, protectionist, reactionary neanderthals. My experience, however, has been that we have been in touch with change. We talk to people here and abroad and what we are talking about is still the newest thing in town.

We do not oppose the export of all technology. You have probably heard a lot of people say, "Well, you know you can't stop technology." They always say that about trade, too. I always say that I don't know anybody who wants to. We are not trying to stop trade or technology. What we are trying to do is regulate it. That is what most nations do and they intend to keep doing it. If the U.S. policy continues to pretend that this is not the case, I suspect we will lose even more of our technological future.

We do object to the export of technology which jeopardizes American jobs, the U.S. economy and the national security. At this moment, for example, Romanians are building computers, Mexicans are making aircraft parts, Venezuelans are producing steel, and South Korea is building ships—all with U.S. technology, all in competition with U.S. production. None of these economies is an open market to U.S. exports.

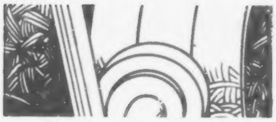
America's technological lead has long been its greatest asset in international trade. That's what people have told us that we are losing. I don't know that we are losing it. But if we are, we have often exported that technology through a new invention called the global firm or global corporation.

The reason that this couldn't have happened before now in history, is that we didn't have the technology for such massive export. We didn't have the computers, the aircraft, the transportation or the communications that would allow you to sit in Detroit or in Tokyo or in some other corporate headquarters and dictate to people who were producing goods and services in Africa or in any other part of the world.

So, in fact, technology has made it possible for us to export technology.

What we have been fighting in the field of international trade is the mistaken notion that the rest of the world is open just as we are, and we are potentially going to lose out because of this. We can lose jobs, parts of industries and entire industries.

Elizabeth Jager, *Economist*
Research Department, AFL-CIO



We have already been through this loss of jobs in a lot of industries. That is why your own experience should give you confidence to challenge the views of the experts. Many union people today are from service industries. They are not only in goods producing industries. These people have been very concerned about practical ways to take care of job security.

But other experts tell you not to worry about imports because everybody will go to service industries. Well, there is technology in service industries, too. We can't pretend that we are isolated from the whole world. A union representative from the shipping industry once said to me, "You don't believe that theory about going into service industries, do you?" He said, "Don't you know that the first jobs that we exported after World War II were the service jobs, the shipping jobs, as our companies, our oil companies and others bought the ships and used foreign flags of convenience. Those are service jobs."

When we started complaining about all of this years ago, we were told that multinational firms were the way of the future, that the firms were only going abroad because unions here were insisting on higher wages and that there was no other way for them to compete. We were told that our productivity was declining. We weren't told that the technology that we were exporting could have improved that productivity.

Every proposal which we have made was a proposal for regulation, not for stoppage. We were told this was stoppage, was neanderthal and a stupid way to operate.

Today, people have developed an awareness of multinational corporations and banks. They now recognize the problem we raised years ago but they have not developed an awareness that the Americans are no longer the only operators in this field. Again, they want the Americans to flagellate only themselves for the evils of our corporations abroad. But we oppose bad practices of multinationals from any country, including our own. All are not giants, all are not totally American.

Let me tell you about one of the newest developments, a computer firm which is not one of the big giants. It's transnational. It's called CYCOR International, in Ann Arbor, Michigan. It found out it could not fight Digibras, Brazil's state computer manufacturing coordinating body, because the state-owned corporations are now the biggest multinationals in the world scene.

So, CYCOR, being a good private enterpriser for the U.S., joined Digibras as a minority partner last year and is now producing the technology for design and manufacture of the equipment and it is doing it in Brazil. That is what we are complaining about—the unregulated export of technology. In this case, it happened to be to a foreign state—which regulates technology.

In 1973 and 1975, we were complaining about the export of satellite technology to Japan. The Thor Delta rocket and launching system, which is considered by space experts to be America's most effective and reliable launching unit, was developed at taxpayer expense and cost millions of dollars in research and development. It was used to launch satellites for Canada, France and a multination weather watcher for seven North European nations. Such launching provided the U.S. with millions of dollars in funds, helping to offset the U.S. balance of payments.

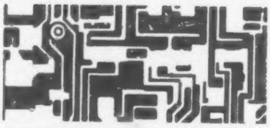
The Thor Delta system had military technology potential. It could carry several hundred pound objects into space orbit, or with a little modification could carry a nuclear warhead in the 1,500 to 5,000 mile range, clearly and potentially a fancy weapon.

The workers, who happened to be machinists in an air base on the West Coast, were very upset about this transfer because of the implications for defense and airspace capability. They feared that the system was being sold for the profit of McDonald-Douglas while the nation lost a basic re-

DEPARTMENT

Elizabeth Jager

Edgar Weinberg



source. They pointed out that the education of highly-trained Americans, millions of dollars in U.S. funds, and expensive trial-and-error testing was being sold at a fraction of its worth to Japan. Later, we learned that the workers were right, and they had lost some of their jobs, and the technology is now a Japanese possession.

We also described to the Congress how the deal was reportedly developed by U.S. cabinet officers and their Japanese counterparts in a 1971 meeting in Tokyo. Estimates at that time were the bilateral understanding could mean up to $100 million in profit to U.S. concerns over four or five years. Just imagine, for $100 million in profits you gave away the whole show.

Of added incentives to the U.S. companies was the agreement by Japan at that time to move ahead on permitting foreign investment by U.S. multinational firms in its automotive industries. In other words, if the Japanese would let our multinational corporations, the auto companies, invest in their country—and what does that mean? That means they wouldn't let them invest there before—that we would allow this technology to go. Both moves would profit stockholders of the corporations involved at the expense of the U.S. aerospace and automobile workers.

The U.S. did take some policy steps in the 1970s with the currency system which resulted in a trade barrier. We now have, relatively speaking, a cheaper dollar. That means that all imports are relatively more expensive. It also means that foreign money is being used to buy up some very interesting industries and parts of the U.S. Investment here—buying up companies—is reversing.

The Japanese now have the electronics industry. The Germans have been buying banks and retail stores. It's even happening in construction. The South Koreans have just paid six million dollars for J. F. Pritchard and Company, a Kansas City engineering firm specializing in heavy construction, petrochemical plants and power plants.

The South Koreans are not only sending imports and capital that buy interests here. They're also sending us janitorial labor. Last month I had a call from the Service Employees at the Denver airport. The president of the local said that a company called World Services, a janitorial subcontractor, is now cleaning the airlines in the Denver Airport using Korean labor and displacing employees made up of two-thirds minorities that will be unemployed with little possibility of finding another job.

The other subcontractors employing American workers were informed that World Services underbid them by as much as fifty percent. In addition they provide the first month of cleaning free. Also, World Services promises to provide one and one-half Koreans for every one American.

The solution was that someone raided the place and found a couple of scared Koreans and sent them home. This is outrageous. The Korean workers didn't do anything bad. It was the company and, possibly, both governments who made this possible. This misuse of labor should be stopped.

Similar things have happened to bricklayers in Alabama. Not too long ago they protested the fact that a German firm brought in some German bricklayers to build a kiln in a Birmingham plant. Similarly, a Mexican employer imports Mexicans to do the work when he comes into the U.S. to do business. This is a global problem. The technology of transportation makes it possible. But none of these countries would let us do the same thing, and they shouldn't.

The reason that we have unions and the reason that we have the kinds of contracts that we have been talking about is because we have laws that make it possible. All of these things can be jeopardized if we fail to note the realities of the world in which we live.

The U.S. seems to be closing its eyes to the fact that other countries do not merely export technology. They want to achieve a better status for their country and to do something that will make money out of the exchange. Sometimes these developments have unfortunate labor results. A study done about 10 years ago, showed a country could get more money out of exporting labor which sends money back to the country than by exporting goods. This is often true with poor countries. We do not seek competition based on labor.

Unlike the rest of the world, the U.S. has no handle on technology transfer because we are an open country, and we are told to think that anyone who wants to regulate anything is trying to stop the world and get off. This is simply not true.

The people who we must get concerned about this are first of all the Congress. The problems are not insoluble. The U.S. can have rational laws to regulate technology and trade and to improve its tax structure so that we don't encourage the technological outflow. We also have to convince America's corporate leadership that a union-free environment is possible, but the history of this country in economics and in technology and in international affairs, proves very clearly that automatic developments in productivity and economics simply don't take place unless there is a force like unions that makes them take place.

I urge you, as a first step in what to do about this change, to lose any lack of confidence you have about what you know. If people tell you that you don't know or that you're not losing jobs, just tell them you saw the jobs go. If they tell you that the Japanese did all this because they were some kind of geniuses, tell them that you don't believe that because it really isn't true. The Japanese are a very able people and some of them are geniuses, but all of this change doesn't happen out of automatic economic theory.

Most of all, tell them to re-read American history, because the changes in technology really created the unions. Unless the unions respond to changes in technology both at home and in the international sense, they will find that the import of labor from literally every part of the globe may very well undermine their own future and the future of labor abroad in a world that is very close, but very far apart.

Contract Protections (Workshop)

Much of what unions can do to protect workers from the impact of technological change depends on the contract provisions that unions are able to negotiate in this area. Each union has different problems and must develop different solutions for those problems.

Many unions have been concerned with the impact of automation on workers and the economy. In recent years, the pace of technological change has increased dramatically, in large part due to what is called the electronic or the silicon revolution. This has resulted in a continual contraction of the rate of employment and has impacted on occupational requirements and occupational shifts.

In 1960, the Executive Council of the International Association of Machinists (IAM) recommended an 8-point collective bargaining program to deal with the problems of technological change. In implementing this program over subsequent years, the research department of the IAM has developed and updated model language. However, many of the collective bargaining approaches of today are really not new or novel in that most of the specific issues raised by automation are familiar to most unions. For example, grievance procedures already exist in varying degrees in one form or another for dealing with these problems, and adjustments to automation will consist to a great extent on the extension of existing rules and practices in contracts.

The current rate and direction of technological change, however, indicates some need for imagination and challenging approaches that may go considerably beyond what is familiar from the past. Obviously, the problems of automation cannot be completely solved through collective bargaining. Nonetheless, over the years the labor movement has taken giant strides through collective bargaining to cushion the impact of technological change and to enable workers to obtain their rightful share of those changes.

Under the IAM's eight-point program, the first recommendation is to negotiate some form of advanced notice or consultation. A company does not make substantial expenditures of capital without a lot of planning and without a lot of investigation. They know, probably, at least a year before the actual machinery is purchased or the technology introduced that they're going to go this route. It is incumbent on the unions to try to negotiate language which requires the company to give at least six months, if not more, advance notice of any new equipment or technology.

Unfortunately, with most contracts there is either a management rights clause or a waiver clause which, in essence, gives the company the right not to tell unions so unions have to go around that and specifically ask for advance notice. One effective argument to use is that if the company is worried about productivity, unions must point out that there is no better way of ruining that productivity than having rumors running rampant through the plant about layoffs and other deleterious effects of automation. Therefore, it's to the company's advantage to give the union and the workers advance notice so that these rumors do not get started. If this is done, introduction of new equipment runs relatively smoothly. If a company believes in the role of the union in their plant, advanced consultation is not too much to expect.

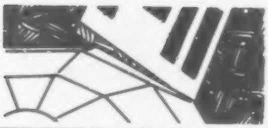
The IAM's second step is to try to get language which provides for the reduction of the workforce—to the degree that new equipment results in a reduction—through attrition. Over the course of a contract, some people retire and some people quit. Adjusting the work force through this means assures that no active employee loses his job as a result of that automation.

Many people argue that this approach stagnates or reduces the bargaining unit over that period, and they're right. This means the union must make a conscious decision on which is more important—the members now represented or the members that may be represented in the future.

The third item is transfer rights, whereby senior employees have the right to transfer to other jobs in that plant or to other plants within that company or within that area. There's an infinite variety of inter-plant, inter-job transfer rights which one can negotiate. The IAM, for example, has a master agreement with the American and Continental Can Companies. It covers about 8,000 employees, and IAM has these multiple plants throughout the nation. The contract says that where a department or a plant is closed down permanently due to technological change or other reasons, the employees in that department, based on seniority, have the right to transfer to other plants. Obviously, the layoffs take place over a period of time since the plant closing is phased in, and the first employees laid off will be the less senior employees. They then have a chance to choose to go to another plant if they want. The IAM has a very fine plant closing protection program in terms of severance payments, supplemental unemployment benefits, continuation of health care and medical coverage, etc., so the person who's laid off has to make a choice—does he want to say on layoff and look for another job at home or does he want to follow the job?

The IAM had charges filed against them under the Age Discrimination Act because of this. The people from the Fair Labor Standards Administration argued that if Plant A is closing, you have 100 people lose their jobs. The last people to lose their jobs are the senior employees, whereas, the first people to lose their jobs have the option of going to a new job in another plant. Their argument was that, in essence, this is discriminating against the older employee because he was the last one to have a chance to transfer even though he was kept on the job. When asked what to do about it, they replied that the senior employee should be laid off first and given the opportunity for a new job—certainly a novel approach to the seniority problem.

Training is another area that the IAM has always spent a lot of time and effort in, and one of the things that IAM negotiates is that if an employee is going to be displaced he should be retrained to run the new machinery. Many times a company will throw out an employee with 10 or 15 years of service to the company and bring in someone off the street who knows how to operate the new machinery. Not only does the company in a moral sense owe the current employee the right to learn this job, it also happens to make good common sense.



Rate retention is also requested for a certain period of time. The IAM has tried to upgrade the wage rates for new jobs—jobs directly related to the new technology—but it has not always been successful in accomplishing this. The companies want to downgrade the new job. For example, with numerically controlled machine tools, the company's argument is that there's not too much for the employee to do. The IAM's response is that there may be less manual work, but you're giving an employee a half a million dollar machine tool and if he messes up, the down time is pretty expensive.

Occasionally, there is a rate problem in the area of multiple machine operation. Historically, the union has taken a position of one man, one machine, but the way the numerical control and some of the other technologies are developing, it is very feasible for one man to operate a bank of machines, obviously reducing the manpower requirements in that plant. There the IAM's greatest success has been in the area of negotiating a bonus or a premium for multiple machine operation, which does not answer the problem, but it does help the existing work force somewhat.

On-the-job training, vocational school, manufacturer's service school, maintenance of income for training employees—all of the expenses involved in these areas of retraining employees should be paid for by the employer.

What about the employee that gets laid off? There probably will be layoffs no matter what you do. The IAM tries to negotiate supplemental unemployment benefit plans, severance plans and special funds such as special income maintenance funds. Equally important is to maintain the employee's medical and insurance coverage for as long as possible. Under the IAM's can company agreements, an employee who is laid off maintains dental, medical, surgical, and major medical coverage for up to four years of layoff.

How about new job classifications that are created? Automation often makes old jobs obsolete and creates new jobs. Along with those new jobs comes the question of who represents those new jobs? Are they in the bargaining unit or are they outside the bargaining unit? Because of this question, it is often beneficial for you to make your recognition clause as vague as you can so that the company cannot point to specific job listings and say that the new job is not specified in your contract.

Along with advance notice, it is very helpful to set up a joint committee to meet with the company and decide what course is going to be taken to have things go smoothly. A lot of problems can be solved if the company will just meet with the union and give the union the benefit of consultation.

After this is all done and after you've minimized the impact to the workers to the degree you're able to, you come to the point of demanding the employees' share of the increased productivity that results from the new technology. You get to the bargaining table and say, "Hey! We want our share of that productivity. We want what is due us." Then you get back to the old bargaining situation of wages, fringe benefits and all of the other items in the economic pie.

Public Employees

Employees in the public sector of the economy also face problems with technological change. Whether it's in a reorganization or in the introduction of a new technology into an office—government employees see their numbers being diminished. If you check the government statistics, you find that at least in the federal sector, productivity has been rising about four percent a year while the work force has stayed stable, which indicates that somewhere along the line some people are being lost.

Some of the American Federation of Government Employees (AFGE) contracts going back to 1964 called for consultation and labor-management committees to meet and work out in advance language and techniques for adapting and handling technological change. Unfortunately, the failures in this area outnumber the successes.

The AFGE has been attempting to cope with this by strongly urging locals to deal in terms of labor-management committees and to meet on a routine basis with management to try to discuss and get input. Unfortunately, many times management's planning, at perhaps an upper level, has already moved the union out of the ballpark by the time management gets around to consulting or meeting with the union.

The AFGE recently got a copy of a green book, which is a book for the reorganization of the entire Social Security system. In tracing that back, many people have reason to believe that this 1978 document was, in reality, put into the works back about 1972. This means that as unions look toward building contract language, locals must look far into the future. Management will continue to try to bring technology along as quickly as possible—not to the advantage of workers, but to use it to the advantage of their stockholders to increase their profits.

Engineers

The International Federation of Professional and Technical Engineers got deeply involved in technological change in the early 60's, not so much in trying to protect the bargaining unit against the ravages of technological change, but in automating the bargaining units. Originally, professional and technical engineers were the ones who automated the jobs that the blue collar workers were on. They were told, "You don't have anything to worry about since this is going to create new jobs for your bargaining units because we're always going to have to automate the shop. That's where the money is. That's where we have to come up with our productivity increases. Your entire units will expand if you cooperate to the nth degree."

Over the years, especially in the early 60's, for the most part, the bargaining units did that. They believed the company philosophy that was expounded at length on almost every occasion. Once the companies got to the point where they had the shops fairly well automated, they then started to automate the white collar jobs, and professional and technical engineers were, of course, adversely affected. The automaters were now going to be automated. The original philosophy was, "It could never happen to us because you can't automate creativity."

In taking a real look at it, it was soon discovered that creativity was only a small portion of everybody's job and that the repetitious portions and the things that could be defined and documented could very easily be computerized and put in some kind of data

bank and recalled for future reference at some later date.

As a result of that, in 1972 the Professional and Technical Engineers convention set up a committee to study the impact of technological change. The report that came out on the impact of technological change on white collar workers, especially in the engineering field, developed a different philosophy from the one that was usually expounded upon at that time. The philosophy was that rather than trying to stem the tide, the idea was to say, "We want to help you put this stuff in place. We want to help you reduce the number of jobs we have, but in return for that, we want some job security and we want some protections to minimize and cushion the impact on the various members of our bargaining unit."

When the complete report, philosophy and the rationale behind it was presented at the 1974 convention, it was found that although everyone was concerned about the prospect of being automated, they were reluctant to get into discussions across the table in an area in which they did not feel competent. They had no problems discussing automating shop workers, but they had a real problem when it came to automating white collar workers.

Beyond that, many members, because the companies had drilled into them over the years that this was going to be an advantage to them, had a hard time accepting the fact that there was going to be any adverse impact on them in the long run. Not only did the union have to minimize the impact on its members, but it also had to develop a whole awareness or educational campaign to try to bring everybody up to where they thought they should be starting from.

Since that time the Professional and Technical Engineers have had varying degrees of success with that approach. Most of the locals have attempted to try to put into place the various provisions that were recommended and some have succeeded and some have failed. The overall program that was started in 1972 has also had some successes and some failures, but it's gaining more acceptance as more people become aware of it and recognize it as a problem.

Beyond that the other major thing is that the philosophy of most of the labor movement seems to have changed now. Rather than resist the implementation of innovative devices, the general philosophy now seems to be the same as the Professional and Technical Engineers are expounding and that is that you should cooperate and sell that cooperation in return for some forms of job security.

In the industrial sector, there have been various problems with this approach. One is trying to get a handle on it. Originally, for the most part there were massive computers. Since that time, there has been a series of major innovations and microprocessors are being installed. Now what used to take a whole, huge room is in a little console beside somebody's desk. Instead of having one massive computer bank, there are hundreds, in many cases, of small mini-computers located next to each individual's desk where they're intercoupled into a CRT screen with a complete, interactive, graphic type system.

Each individual works on this type of unit which is ultimately connected into another level of computers, and what they've actually developed now in the more sophisticated companies is not one main, large, huge computer that does everything and everybody had access to it. You now have a whole hierarchy of computers. It's impossible for Professional and Technical Engineers to maintain a desired degree of control. Basically, it has weakened the union's bargaining position.

The reasons why companies go this way vary, but for the most part companies cite productivity improvements and cost-saving advantages. In the industrial sector, however, there seems to be another major advantage or motivation from the companies and that is that it's basically a very subtle, union-busting tactic.

They put a series of computers in place, they end up changing job titles and in some cases, rewriting the job contents. They use that as an excuse for assigning non-bargaining union personnel to the equipment, and what should normally have been an accretion to the bargaining unit is now an all-out battle just for protection.

You hear so-called experts say how ultimately it's going to mean more work since different types of jobs will be available, but that's assuming the bargaining unit members are going to be ultimately able to train for those jobs and ultimately able to secure them. In many locations, the company, rather than hire bargaining unit members and train them on these jobs even though they may be outside of the bargaining unit, is bringing in people from outside the company—new hires and others from other sections in management—apparently to minimize any attempt to organize or to bring the work back into the unit. Once they do that, it's a very difficult task.

One of the worst problems is trying to keep the work in the bargaining unit. Engineers don't have tools of the trade, for the most part—their work is based on thought processes. So when you start arguing about whether something is an infringement or not, you're not arguing that just because this individual happens to be on machine XYZ or he's machining parts, that that should be a function of your bargaining unit.

What you're saying is that because this individual is now going through a thought process that was similar to the thought process used previously by members of your bargaining unit, and that work should be in your bargaining unit. It's a very difficult argument.

That is even a more pressing issue across the bargaining table than economic issues because what good is a raise in pay or increased insurance benefits or pension plans if you don't have a job on which to earn that raise or to benefit from those benefits?

Convincing members that they should throw in contract language, especially on technological change, and make that a major bargaining goal and hold out on signing a contract that may otherwise be very satisfactory until they attain that is a very difficult task.

Training and Educating for Change

Reese Hammond

Andre Maurois states, "To work is to transform or to move things and creatures in ways that will render them more useful or more beautiful." The worker aspect of technological change means the increasing presence at the workplace of equipment and methods capable of replacing human effort with machine calculating ability, quite often with super human accuracy and speed.

To cope with technological change, then, it is necessary to determine how to keep the "people" element of the production equation employed in a capacity that is personally rewarding both psychologically and economically, dignified, and in a fashion that contributes to a good society—one more useful and beautiful for everyone—while machines and computers do more of what we used to call work.

In narrowing down a response on the part of operating engineers to the problem of coping with technological change, I attempted to play the role of the sophist to address only those problems and opportunities over which our union and its affiliated locals have some control.

It was a defensive action and I found this approach workable and satisfying—workable because our union has a great deal of control over the preparation of our members' vocational skills, and satisfying because these kinds of problems and opportunities are bite-size. They can be handled, and specific programs can be designed to respond to them.

In the last resort, coping with technological change means coping with life in 20th century America. An institution such as the Operating Engineers, and I might submit, any union, can best serve its members by providing opportunities to equip their members with the three types of education required of a total person—education for work, education for life, and education for public service.

Over the past 20 years, the Operating Engineers has developed an apprenticeship training program designed to provide continuous total training opportunities for all of our members—a chance to learn from the day you first walk on the job until the day you pick up your first pension check. For our 5,700 apprentices, of whom 33 percent are minority and 2.8 percent are women, it's an opportunity to earn and learn—learn not simply what to do, but why it is done, and an opportunity to *earn* while that learning process takes place.

I submit that apprenticeship is the most nondiscriminatory learning system there is. You don't have to be rich enough to drop out of society for four years to go to college. You don't have to be a genius and you can continue the development of your own lifestyle while you prepare for a career.

In addition to our interest in apprenticeship, we have developed upgrading and skill improvement programs which are available to all our members. As you might guess, training for operating heavy equipment is expensive business, and we have in place in 62 training sites across the country some $65 million worth of government property from our friends in the Labor Department, plus some $40-$50 million more of our own equipment, and that's just one bite out of the apple. Operating costs are terribly expensive. For instance, to run one of our training devices, a D-8 bulldozer, for one hour requires 10 gallons of diesel fuel, and the last report I got on diesel fuel, it was 96 cents a gallon.

We spend $21 million a year on apprenticeship training. It was voted out of wage settlements into apprenticeship training, rather than into our members' pockets—that is roughly $84 a year per covered member.

In the last 10 years or so, we have developed 65 workbooks and instructor manuals, dozens of slide presentations, training films, safety films, and brochures covering every aspect of our trade. All of these educational and training aids are available to all our apprentices and journeymen.

For the past three years, we have spent over $1,200,000 in doing the necessary research to change our apprenticeship program over from a program based on blocks of time—three years, 6,000 hours; four years, 8,000 hours. We're going to replace that with a performance based program for which we are developing valid performance tests to be given to our apprentices and our upgraders. At the point when they can successfully pass this nondiscriminatory test, they will have finished their training for that particular task.

Several years ago, we took a hard look at post-secondary education, and determined that our apprentices were being shortchanged in the all-American game of credentialism. So we created what we call the dual enrollment program, where we work with about 22 or 23 cooperating community colleges in which our apprentices who are indentured to learn a trade also matriculate into the cooperating college, meeting their standards for matriculation, and receive academic credit for their related training and also academic credit for their on-the-job training.

I learned several years ago that if you want to get academic credit, you don't call it on-the-job training, you call it a practicum. If you put the right kind of Latin label on it, most people will talk to you about giving academic credit for it.

Oddly enough, we got into this when I read in the *Parade* magazine a decade or so ago that there were some young ladies from Bryn Mawr College who were getting credit for a life skills course. They were greasing cars and gassing up cars in a gasoline station. I said to myself that our guys do a lot more of that type of thing and they ought to be able to get some credit too. We haven't gotten it from Bryn Mawr, but we have gotten it from a number of other places.

Currently, roughly half of our apprentices are banking college credit for their study and for their practicum. Both in our performance based testing and in our dual enrollment program, we are interested in what you know, not where you learned it.

More and more of our local unions and programs are offering GED courses, independently or in conjunction with established

Reese Hammond
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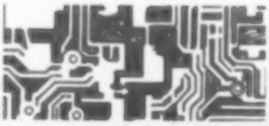

school districts. At the post-secondary level, we are working very closely with the George Meany Center for Labor Studies in their development of a program leading to an associate degree in labor studies.

Participants in that program are currently in four pilot projects with four cooperating junior colleges and a number of cooperating apprenticeship programs. Once again, individuals who are indentured in any apprenticeable trade can matriculate after they have been indentured. They take a course which is composed roughly of one-third credit for their apprenticeship practicum and their science trade theory courses; 21 credit hours in labor studies that are being developed by the George Meany Labor Studies Center specifically for this program; and one-third off-the-shelf courses that are offered in the community college.

A very important part of this pilot program addresses what I have always felt is a shortcoming in our own dual enrollment program in the area of science, engineering or technology. That is, while they were not exactly terminal associate degrees, there was some very real problem about articulation if, in fact, one chose to pursue further education. So an important part of this program is articulation with senior colleges.

Because technological change affects us so much at the workplace and in our life in general, we believe it is essential to maintain educational options for our members in the 1980's. To the extent that credentials are prerequisites to keep options open, we need them, and we are going to keep them available to our members.

In the Operating Engineers we hope to assist our members in coping with technological change in two areas by continuing to offer a broad range of technical and vocational learning opportunities to keep our members employable, and by continuing to lay seige to the possessors of educational credentialism so that our members have access to education. Education is power, and without power you are nothing.

We expect to do this in two ways: by continuing to analyze our trade and our society to determine the *artificial* barriers to self-fulfillment and the *genuine* barriers to self-fulfillment. We expect to blow away the artificial barriers and develop the most effective programs we can to overcome the *legitimate* hurdles that stand in the way of real self-fulfillment. At the same time we will join with others of like-mind to explore an updated version of what work is.

Specific contractual responses on the part of the trade union movement are essential, but if we don't play the role of cushioning the onward march of technology, then we will have failed our members.

After the collective bargaining agreement is signed and after the new wages are being paid, the simple truth is that individuals have to learn how to cope with technological change individually. Unions must continually fight to keep opportunities for growth and positive response to technical change available to their members.

Reese Hammond

Reggie Newell

Retraining: The Need for Flexibility (Workshop)

Two basic areas of concern to workers in education and retraining are the combination of the technological pressures being placed on them and the unnecessary efforts of management to develop a union-free environment. Technological change often has a way of developing on its own without any specific conscious development, but those pressing for a union-free environment are going at it consciously and the problem needs to be addressed.

Therefore, in the coming period unions need not only to protect the interests of their members, but also to improve their conditions through education and training. This should be approached from two directions—what unions can do about education and training through collective bargaining, and what unions can do about education and training through political action.

Training programs have become a catch-all solution for what is going to be done about automation, technology, and the displacement of workers due to foreign trade. Consequently, one of the most vital items facing the trade union movement is a consideration of what these training programs are going to be. Who will control these programs? Who will get into them?

In the old days, the trade union movement used to say, "That's the teacher's job. Let the schools take care of education. We've got other important things on our agenda." Unions today need to very seriously consider the nature of the training, who provides the training, who controls the training and who benefits from the training.

There are ways in which trade union leaders can attempt to deal with these training problems. In the first instance, there are tuition refund plans which have existed since 1904 in the United States, but were mostly given unilaterally by companies and were completely controlled by companies. Very few unions actually negotiated and wrote into their collective bargaining agreement a tuition refund plan. The ones who do have this are still at the mercy of the company. If a worker applies to the company and the company says "no" then there's not much the union can do about it unless it's subject to the grievance procedure, which tuition refund plans usually are not.

It is estimated that only three percent of workers use these plans, which raises the question of whether or not workers are really interested in these educational programs. When workers are asked about this, unions often discover that first of all, the workers don't know about it, and secondly, they assume it's for someone else or the company tells them it's for someone else.

A lot of workers complain that they don't have the time to take advantage of educational opportunities since they would have to do so in the evening when they have families to care for.

In many industries, unions find that those who utilize the educational programs are those who want to get out of the plant, usually technicians who already have an educational background. Unions have found that these types of employees will seek out employment where the contract does provide for partial tuition refunds. The average rank-and-file members do not enroll in educational programs.

Another area of great concern is in-plant training. There have been many estimates as to how much money management spends on in-plant training—estimates ranging from two billion to sixty billion dollars. Unions need to have more control over this in-plant and upgrade training.

In apprenticeship, which is one of the most satisfactory training systems in place in the U.S., unions are doing well because they take a major responsibility for the nature and quality of their apprenticeship program. Building trades and maritime trades unions have been negotiating trust funds for training for a long time. These trust funds are mandated by law to be jointly trusteed by labor and management.

One of the problems in the area of tuition refunds is that if you negotiate a product which costs money, the company has a vested interest in seeing that this product isn't really used very much because every time it's used it costs $950 a year or more to refund tuition to a worker. Now, conversely, in the trades, the five, ten, fifteen cents an hour or whatever that goes into the trust fund cannot be used for anything except training and retraining, and there's an equal input as to how that money is used by the labor trustees and the management trustees.

Many companies will resist this approach by declaring that they are already spending millions of dollars in training. The problem is that the unions have no control over that training, whereas they do with a jointly administered trust fund.

Industrial unions have just begun to think about this in a serious way. For instance, the UAW is negotiating a step further for paid educational leave, or time off the job for education and training, paid for by the company, without loss of income on the part of the worker.

There should also be joint labor-management advisory committees on education and training. Even if this involves nothing more than a meeting of the shop committee and the personnel department, it can still accomplish the objectives of a joint labor-management committee.

There's also the question of promotion. What shall be the most significant factor in promotions—seniority or education and training? Most people are concerned that seniority remain as a cardinal point in promotions, not educational qualifications. However, if educational qualifications are required for job transfers or job promotions, then union members have to be entitled to engage in that educational activity.

Both the company and the employee have a stake in education and training. The employee usually has to learn something that will be helpful to the company if they're going to pay for it, but at the same time the employee should be learning something that could help him to get another job if necessary.

Companies have always wanted a union-free environment. Today, they have new techniques though and unions must adjust to those techniques. This is why unions need more trade union leadership training. Few unions substantively engage themselves in

trade union training and consequently few union leaders know how to protect their members against the kinds of things that are now being introduced into the shop.

Two types of education are needed. One type involves educating union members to the need for further education and training, and the other type involves the actual education and training program.

For example, BRAC got a railroad company to agree to train BRAC members as traffic weight clerks and promote from within rather than hire outsiders. All the members had to do was sign up. However, the members didn't take advantage of it since they didn't feel an immediate need to transfer or upgrade.

One member said, "Why do I want to be a rate clerk? What do I need it for?" Shortly after that, the same member lost his job due to new technology coming in and he wished he had taken the course. This demonstrates that unless members can be educated as to the importance of taking advantage of educational and training programs, then they would be better served if the company offered retraining at the time new technology is brought in and their jobs are abolished.

Responses vary with the types of formal educational programs available. Some programs have been abolished for lack of interest, while others must seek larger classrooms to accommodate the ever-increasing enrollment. Many union leaders believe the response depends greatly on the type of selling job done by those involved with the program or by past program participants.

Quality of Work Life (Workshop)

Left to right:
Michael Sidell, Reggie Newell, Harvey Schwartz

A quality of employment survey was done recently by the University of Michigan for the U.S. Department of Labor. This survey was made of 1,500 workers and it looked at the jobs and the perspective of the individual workers. The overwhelming majority of these workers felt they were satisfied with their work, but in the last few years there has been a decline in that satisfaction. Sociologists, psychologists and economists are trying to determine why this has come about, but the reasons cited by workers for their declining satisfaction are significant in terms of evaluating the quality of work life in our economy today.

Forty percent of those questioned said they lacked freedom to decide what to do on the job. Thirty-eight percent said they had little or no say on what happens on the job. Forty percent reported highly repetitive work. Thirty percent said they had no feedback on the quality of job performance. Forty-two percent said there wasn't enough time to get everything done on a job. Forty-seven percent said rules and regulations cover almost everything they might do or say. Moreover, thirty-six percent felt they have skills they cannot use on their jobs and thirty-two percent said more formal education is required by their jobs.

Now, these types of work conditions are not conducive to steady attendance, good workmanship and commitment to the company. Evidently, there is a problem in this country in the quality of work life for a sizable proportion of the work force.

The level of education in this country is rising. The average educational level of attainment of the work force today is about 12½ years. That means that half the work force has a half a year or more of college education. This group of college-educated workers is increasing much faster than the job opportunities for them, which leaves a potential for a feeling of frustration on the part of young people in not being able to do what they set out to do.

Common complaints by workers today include: compulsory overtime, increased job pressure as a result of a reduction in manning, operators being considered extensions of machines, quality deterioration as a result of increased emphasis on speed, less toleration of human error with automation, more discipline and more company reprimands as a result of workers being too helpful to customers. All of these complaints have been brought on as a result of increased technology in the workplace.

Historically, technological improvements in the workplace have taken place alongside improvements in the physical surroundings, in such areas as air conditioning, better ventilation and newer buildings. However, one of the problems of coupling technology to the workplace is that it tends to require a certain amount of cost-effectiveness. In other words, things aren't done in the workplace to make people happier—things are done in the workplace to make the job less costly or to make workers more productive.

When an employer invests in new technology, he wants to get something out of it. It doesn't make any difference whether it's computers, a new form of quality of life-type experiment, or anything else—he expects to get something out of it. The more capital that's been invested versus labor, the more concerned an employer becomes about getting the most out of his capital investment, and the less concerned he becomes for the welfare and security of the work force. This is part of the problem with computers. When a new computer is installed, the employer wants to use it day in and day out. You get to the questions of continuous coverage and shift work. This calls attention not only to what happens on the job in terms of stress put on workers working eight hour shifts for extended periods of time, but also what happens in terms of increased stress in the home as a result of shift work.

The Swedes, British, Germans and French have done a lot of studies in the area of shift work and various kinds of stress. Some of the things that they note about shift work and the quality of life that stems from it is that there's an increase in juvenile delinquency, divorces, domestic problems, stomach disorders, cardiac problems and a variety of stress factors that are related to the job situation. The French, as a result of their studies on shift work, have passed laws limiting the use of shift work, and addressing special problems stemming from shift work.

When unions see increased and improved technology coming down the road, there are a lot of things to be explored in collective bargaining to make that technology more humanly acceptable. If you leave the solution to this problem exclusively to the employer, the solution will be directed principally toward improved productivity with very little emphasis on the impact of technology on the quality of life, both on the job and off the job.

Flexitime is an area which gives employees more control over their lives. In effect, flexitime means that if you come in a little bit late in the morning, you can work a little bit later in the afternoon. Oftentimes, when companies go to flexitime there is a decrease in the amount of overtime hours being paid. This tends to indicate that hours are being adjusted by supervisors to permit people to meet scheduling demands through flextime rather than overtime, which should alert unions to the need for negotiating safeguards against employer abuses of this system. The 8-hour day, with overtime for extra hours, no matter what occurs on other days, must be protected. The worker, not the supervisor, must have the freedom to choose different work schedules.

Many people feel that employers schedule workers so strictly that they are denied any feeling of responsibility or pride in their work. For instance, a cable splicer for the telephone company reported that for three years he worked under a system where he was given assignments and he worked under a schedule which he developed and which gave him a great deal of pride in his work. In 1970, the company instituted a labor unit program and the foreman dictated how long each job was to take. This worker lost pride in his job and the company lost by often allocating eight hours for a three hour job.

There are also situations where workers are chided for doing too well on the job because it "takes too long" or "doesn't fit into the system." Even though the employer is willing to accept lower quality, it is hard to take pride in a job performed under these circumstances.

Such examples demonstrate that while there are plenty of articles in professional journals about employee attitudes and employee concerns, relatively little seems to be happening in this area.

There are instances where grievance committees are able to meet with management representatives and discuss job-related problems outside of formal grievance procedures. However, many union people feel that within the past two or three years, it has become more difficult to talk with management about such problems. One reason for this may be because companies are hiring younger managers, often straight out of college, who are not union-oriented and have no prior experience in employee relations.

One thing that is crucial in reaching management is to link job stress to cost or productivity. If it could be established that job pressures are resulting in excessive costs in terms of low productivity, turnover, absenteeism, the inflationary impact of job stress could be illustrated in the language that management understands.

Health is another area of concern. One bargaining unit reported seven members out on disability due to job-related nervous breakdowns and one even committed suicide.

Organized labor must document the need to improve the quality of work life not only to management, but also to the public and to government. Strengthening the labor law would do much to alleviate job stress. Unions must be protected in their right to fairly organize and fairly bargain a contract that will improve the quality of work life for all working people.

Technological Change and a National Employment Policy

Ernest Green

The first major impetus for employment and training activity in the U.S. was in the early 60s and that was due to the impact of automation on jobs. The result was the enactment of the Manpower Development and Training Act of 1962, legislation which ushered in a new era of active labor market policies in this country.

The response of those of us who have been in employment and training is not to stand in the way of technological progress. Rather our concern is first to assure that all workers from all segments of the population have access to the skills and occupations associated with new technologies, second to help those workers displaced by technological change to receive income maintenance and where needed, retraining, relocation assistance, and to adjust to their changed situation.

We all recognize that it is critically important both to fight inflation, to improve our competitive position abroad and to increase the rate of productivity growth in this country. In recent years, however, the pace of productivity increase in the U.S. has slowed considerably. The annual growth, the GNP per worker, averaged only a tenth of one percent in this country during the period of 1974 to 1978 while the figure in Japan was 3.2 percent and in Germany and France, three percent. Clearly, technological developments such as computer assisted manufacturing, office equipment, engineering and design can all contribute significantly to narrowing this productivity gap.

However, of equal importance to investment and new technology and the expansion of existing capital is investment in human capital through training and education. For example, there are very real implications for the future productivity of our economy when hundreds and thousands of black youth in our cities are chronically unemployed and cannot or will not develop the technical skills and work disciplines necessary to make them fully productive workers. I would suggest also that there are grave losses in potential productivity when many women, Vietnam era veterans, handicapped persons and people in rural areas work far below their potential.

Ernest Green
Assistant Secretary for Employment and Training
U.S. Department of Labor

This is the business that we are about in the employment training administration—the business of building human capital. Our principal vehicle, of course, is the Comprehensive Employment and Training Act (CETA). In facing the challenges of technological change I see the role of the CETA program as assuring that our clients are equipped to meet changing occupational requirements which result from the introduction of new and modified technology and that production process.

When I refer to our client I am speaking about the unemployed in the work force who come from economically disadvantaged backgrounds. In proposing the new CETA reauthorization in the Congress last year the administration made a conscious choice to target the resources of employment and training programs to meet the needs of those who are most in need of help. How then can we assure that our training and other job preparation programs for these disadvantaged citizens keeps pace with changes in the content of jobs and in the technology of the workplace?

While our primary focus in CETA is on the disadvantaged workers in our society, we have become increasingly involved in addressing the problems of workers who have experienced stable employment, but now find themselves suddenly displaced from their jobs. In the various programs legislated by Congress we are now providing adjustment assistance to workers who are unemployed as a result of competition from foreign import, as a result of expansion of the Redwood National Park and the lumber-producing areas of California, as a result of employment contraction associated with deregulation of the nation's airlines. In each of these cases adjustment assistance involved different packets of unemployment compensation benefits, retraining allowances, relocation allowances and other services.

I believe personally that this reflects a growing trend in Congress to look toward special income maintenance and labor market policies to assist workers in adjusting to anticipated losses of employment due to factors far beyond their control. My own personal view is that we have reached a point in which we must begin to develop a comprehensive approach to move towards a solution in which all workers who are displaced from their jobs involuntarily whether because of imports, deregulation, or technological developments will be afforded in addition to unemployment insurance the possibilities of being retrained and where necessary relocated to new employment.

I also think we need to seriously consider the possibility of some form of early-warning system about impending layoffs, an approach which is commonplace in European countries. Another possibility we are looking into is work sharing. We expect a project on it to begin later this year. Since it is a tool based on redistribution rather than economic growth alone it might be very useful in the present anti-inflationary climate with its relatively limited use of fiscal and monetary policy and public service employment to explore work sharing as an anti-recessionary tool. This could involve the partial replacement of income loss since workers would voluntarily accept the shortened work week in order to prevent alleviated layoffs by the firm.

Now let me stress that this is voluntary and many firms would not be interested, but some firms would realize important gains from participating in this effort. In California, for instance, organized labor's reaction has been wide ranging and we think at this point there has been no serious objection. In fact, some of the earlier ideas of work sharing developed from some particular labor organizations, particularly those in the garment industry in New York.

Ernest Green, Rodney Bower

Here are a few advantages in work sharing: more equitable distribution of unemployment and its attendant social and economic costs (as shown during the 1975 recession in Europe, nations with work sharing had a much higher percentage of unemployment as partial unemployment); lessening of the adverse effect of a recession on minorities who are generally on low seniority jobs and thus the last hired and the first fired; less loss of private fringe benefits; and less downturn in consumer spending.

Progress in this and all areas of employment policy will depend greatly on a strong partnership between government and organized labor. I think the American labor movement and American workers in general are striking a new chord that they want to be involved at the design point of technological change and have all considerations as they impact on people, not just on the productivity of goods, but on people.

Ronnie Straw

Herbert Levine

Innovation Policy: A Need for Labor Involvement

Thomas Moss

The current analysis of the U.S. technological innovation problem includes a variety of things—tax problems, levels of capital gains tax, incentives for innovation, patent law, anti-trust law, regulatory law, the issues of basic government investment in research and technology development, skilled training, import-export issues, and related matters. It's a pretty standard package.

The real question, I think, given all these kinds of ideas, and given the statistics about foreign and domestic patents, and other dismal indicators that are floating around, is why we haven't had any major new innovation policy thrust by now? Let's look at some of the factors that make the formation of innovation policy a little less clear cut than it is on the surface.

The first problem strikes at the very heart of the whole thrust for incentives for industrial or technological innovations in this country. That is, a few people at least are asking whether we really do have a technological innovation problem. A lot of people are thinking of the solutions to the problem, but a few are asking whether we really have the problem in the first place.

I think we ought to at least examine whether the innovation problem in this country is best seen not in terms of tax disincentives, or patent policy, or other similar matters at all, but instead in terms of a disillusioned work force that naturally does not break its back for creative initiatives in the environment in which it's forced to work.

What really brought this to mind was the recent patent lawsuit against a major national retailer. A young inventor, presumably the kind who should be a prime source of innovation in our system, was victimized in almost every possible way in his dealing with his employer. Finally, after a long struggle, he will be awarded $60,000,000 for the proceeds from the product of his invention, despite the efforts of his employer to deprive him of a fair share. But imagine the lack of incentive that this young inventor had, where the company suppressed the value of his invention and deceived him at every point along the way, compared to a case where he could have confidence that a substantial portion of that $60,000,000 would have been his as a reward for putting his heart into his inventive capacity.

As he pointed out afterwards, he really didn't ever dream or think or want $60,000,000. If he'd gotten $600,000 he probably would have been more than satisfied and would have had all the incentive he needed. However, $10,000 was not enough. I think this incident gives us a clue that at least some of our innovation problems may be in terms of this aspect of the professional work place, and that is something that I hope the technologically oriented politicians or committees will not forget.

A second problem I have seen in implementing an innovation policy involves the actual implementation of ideas and the establishment of priorities. There is a "Presidential Decision Review Memorandum" on a U.S. innovation policy in process right now. There was an innovation task force led by the Department of Commerce. It has recommended a package of policy steps to the President. They probably will include basic tax, patent, trade and regulatory changes, so something is in the mill.

Now what will happen with that? One of the problems in getting action on the recommendations is that, from Congress's point of view, innovation is not the only important goal they wish to pursue—even though it may be the goal of the innovation task force. There are a lot of questions that are going to override innovation goals when it comes to implementing this policy; questions of equity and transfer of wealth; general health and welfare protection; etc.

Also, the time span of occupancy of office of either the administration officials, or the congressmen involved in decision making, is often much shorter than the time span for implementation of some of the innovation ideas that we're going to have to put into place. That will be another problem in implementing any long-term strategy for innovation.

Tax measures, as we've learned in dealing with the problem of forming a coherent energy policy, are almost impossible to target very accurately and produce the results that one wants to have. It's just not possible in the Congress to fine tune a tax incentive very well and really get it to the people who need the help. The contrast between suggesting tax incentives, and targeting them accurately, shows most clearly the gulf between forming policy and implementing it.

There probably will also be some suggested changes in regulatory law, supposedly to help promote innovation, possibly even occupational health laws. Once again, though, I think one can foresee difficulties in making these changes in an orderly way. The adversary relationship that has grown up on issues of occupational health, and environmental and public health protection, is so intense that it's going to be very difficult to fine tune these laws to really promote innovation in an effective manner. We constantly see newspaper ads enlisting or inflaming the public for and against certain kinds of regulatory and

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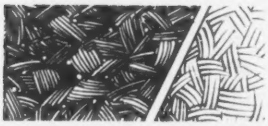
Dr. Thomas H. Moss
Staff Director and Science Advisor to Representative George E. Brown, Jr.



occupational health measures, and that is just not the climate for sitting down and working out what really would make the work place safe and yet make it productive and economically viable.

Even the question of direct investment by the government is going to be fuzzy when it comes down to implementing a policy. I mean direct investment to include either loan guarantees or direct federal funding for technology development. The question is to whom do those direct investments go? Do they go to new players, new firms that are developing, or to established ones? Do they go to small companies or big companies? These are typical of the traditional broad social and philosophical questions that have slowed down all kinds of strategies for innovation.

"Innovation by whom" comes out as an issue especially in terms of patent law. There's going to be a lot of movement for liberalizing or changing the patent laws one way or another, but these are different factions. Small companies see strong binding and long-term patents as a way of increasing the power of big business over the marketplace. Big companies, of course, often see any loosening of patent rights, such as compulsory licensing of patents, as a way of weakening their economic position, and losing their investment in their patent rights.

I think that the implementation of these ideas often comes down to a question of what kind of planning we're able to do in this society. Much of the implementation problem arises from questions such as who benefits from an innovation or a technological change policy, who benefits from the patent laws, who benefits from the tax laws, who is dislocated, and who is compensated for that dislocation? If any one element of the strategy is pursued independent of the others it's going to become incoherent. It's going to end up like our energy policy—internally self-contradictory.

There seems to me to be only two possibilities of relieving that problem. One is a much more centralized form of economic planning, a form of economic planning that allows a dislocation in one sector to be compensated for in an entirely different form in another sector of the economy.

Business audiences obviously don't like to hear anyone talk about central economic planning. They like much better to hear about cutting the capital gains tax as an isolated action. There's no doubt that there will be a big push to cut capital gains tax as part of the whole problem of technological change. Business does not, however, like to see that cut in capital gains predicated on and integrated with something like a relief for property tax so that employees can work and live close to their work place, or a relief in the income tax so that there is enlarged incentive to earn your salary instead of losing it. They do not naturally suggest a form of worker relocation insurance as a necessary corollary to incentives for industrial change.

The kind of idea that is developing in our minds in terms of resolving these tensions is related to very decentralized local kinds of planning initiatives, planning through professional organizations, scientific organizations and local labor organizations for technological change. It's a complex world and it may sound ridiculous to talk about planning for technological change on a local level, but I really don't think there's any alternative.

I warn you that the whole thrust for innovation is going to give opportunity for a lot of self-interest to be pursued, probably on labor's part as well as on management's part. So we need the local cooperative effort, but we still need to keep the caution up about what everyone's motivations are, at least until we have a period of nonadversary relationships.

Thomas Moss

Where Do We Go From Here?

Jack Golodner

In talking about technological changes, one thing becomes clear. The future is plastic. It still can be molded. We are not moving helplessly on some predetermined path. There are many options and many paths to the future. And, if we put our minds and organizational skills to it, we can influence the paths selected and participate in the creation of our future and our children's future.

Projections of technological change often remind me of the great past prognosticators of technological change. For example, that high level government study commission which after four years of work reported to King Ferdinand that the Indies could not possibly be reached by traveling west. The British railroad designer, Thomas Tredgold, who declared in 1835 that “any general system of conveying passengers at a velocity exceeding ten miles per hour is extremely improbable.” And Vanevar Bush, President of the Carnegie Institute, who in 1945 advised President Truman that the atomic bomb “will never go off. And,” he said, “I speak as an expert on explosives.”

Does this mean it is futile to try to anticipate technological change? Not at all. It does remind us, however, that the assessment process is not an exact science, and because of this, we cannot sit back and rely on so-called experts to guide us. If we are to be true to those we represent, we must do our own independent thinking. Let's put this bugaboo about futurism and assessment into perspective. The claims of experts are statements of opinion, not conclusions of fact. They are opinions offered up in never-ending debate over which path to take, what option to favor. Do we speed up or slow down the rate of innovation in a particular area? Do we go for retraining or early retirement to soften the blow of rapid change? Do we regulate or do we allow the marketplace to govern totally?

Organized labor must participate in this debate because it's much too important to be left to government and management. As Charles Kettering of General Motors once said, “We should all be concerned about the future because that's where we will have to spend the rest of our lives.”

You and your organizations, representatives of the interest of working people and their families, you have a perspective, a point of view that must be heard in this debate—the human perspective. This is the message I heard yesterday when Glenn Watts and Fred Kroll, Bill Schroeder, and others from the labor movement spoke to us.

It is our job to keep insisting, indeed demanding, that the human element be added to all assessment equations. Profits and productivity are not the objectives of change, but are really a means to an end, that end being to enhance the dignity, the well-being, the quality of life for every human being.

Change, yes. But change for the sake of change—blind, unknowing, uncaring change, no. Our society knows well *how* to bring about technological change. It is your job, it is the labor movement's job to constantly ask not how, but why. If the answer is only profit, it is not good enough. The answer must be at all times, “This will make life better, easier, richer for humankind.”

This questioning role is not an easy one in a world where the buck, the yen and the pound have been deified. But since when has it ever been easy for those who assert the rights of people? It is a difficult job.

It reminds me of a story about a hunter who was walking through the woods on a very cold, bitter cold winter day and he saw this little bird half-frozen to death. He picked it up and tried to keep it warm with his hands, but it didn't work. Then, he saw a pile of fresh cow manure, and he took the bird and put it into the manure. The manure warmed the bird and it revived and began to sing. Well, no sooner had it started singing than a fox who was going through the woods heard the bird, found it and ate it up.

The moral of this story is that the one who gets you into it is not necessarily your enemy, and the one who gets you out of it is not necessarily your friend. But while you're in it you better not just sit there and sing. You better assess your real situation and do something about it or it's going to get a lot worse. So let's start doing something about our future.

Jack Golodner

We need to develop within our individual unions and the labor movement the capacity to challenge the judgments made about technological change by management and government and evaluate the impacts of change in human terms.

We should strengthen our mechanisms for exchanging information. No union, like no man, is an island. We can all learn from the experience of our brothers and sisters in other trades and industries. When the bell starts tolling for one, it's time for us all to start taking another look at our contracts.

New technologies mean new occupations, new needs that must be addressed, new problems to overcome. We must counter with new bargaining positions, new organizing methods, and new legislative initiatives. As Abe Lincoln once said, “The dogmas of the past are inadequate to the stormy present. We must think anew.”

Jack Golodner, *Director*
Department for Professional Employees,
AFL-CIO

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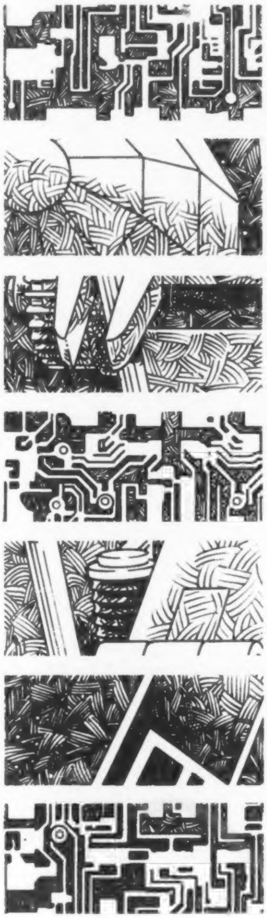

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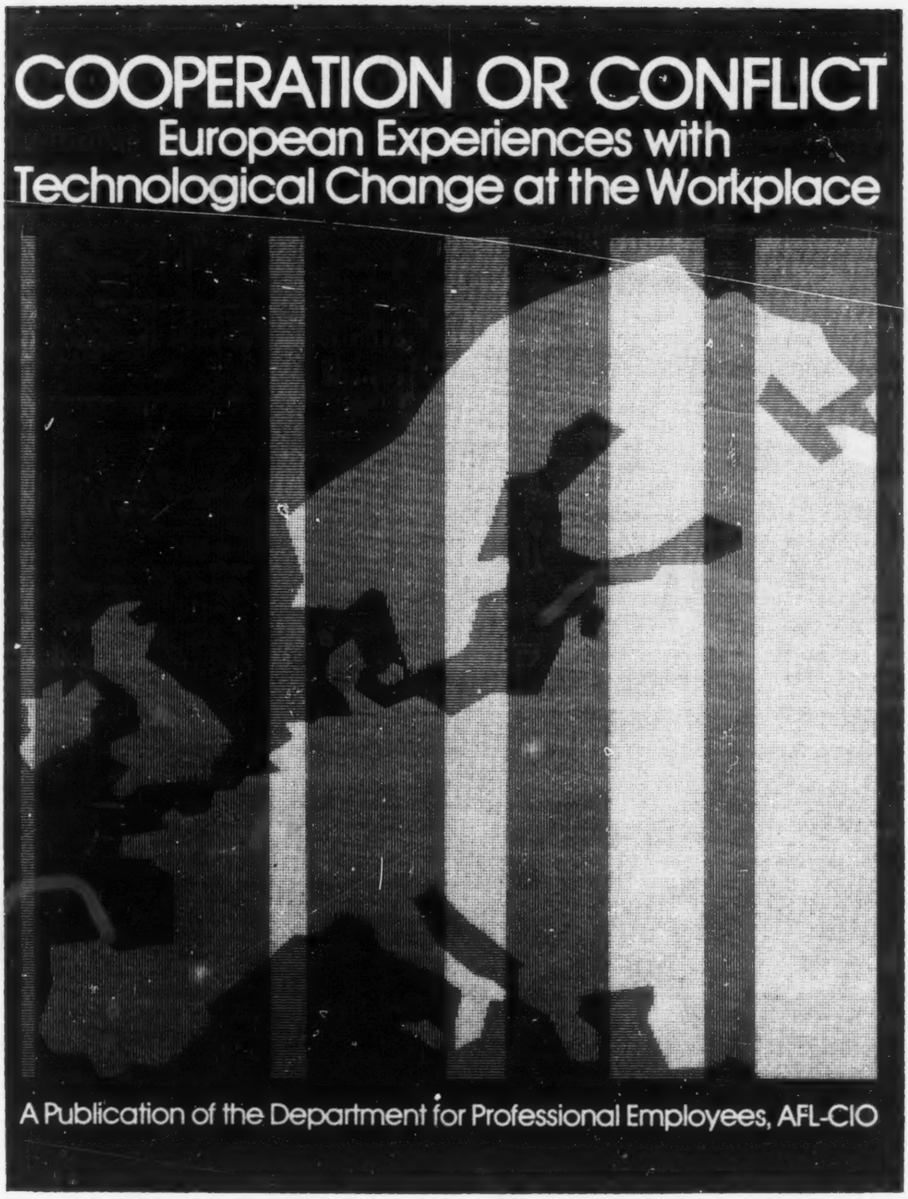

COOPERATION OR CONFLICT
European Experiences with
Technological Change at the Workplace

A Publication of the Department for Professional Employees, AFL-CIO

COOPERATION OR CONFLICT

European Experiences with Technological Change at the Workplace

BY: Dennis Chamot and
Michael D. Dymmel

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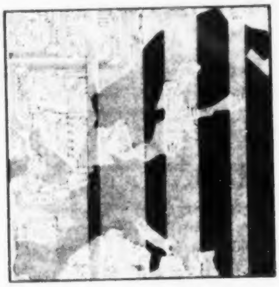
Introduction

Adapt or die" has always been the rule governing the evolution of life on this planet. The same is true of organizations and professions. In those cases when we are faced with change occuring on a massive scale, and with great rapidity, we often refer to it as revolutionary.

We are today on the verge of a revolution that will leave virtually no form of work unchanged. The application of computer and microchip technologies, coupled with the enormous range and flexibility of developing telecommunications systems, offer a potential for change which may be every bit as profound as that caused by the first Industrial Revolution.

That occurrance, from our modern perspective appearing very rapid, but in reality continuing over many years, transformed much of the Western world from agricultural communities to industrial giants. There is talk now of going beyond the industrial age into the Information Era, when power and wealth will derive more from the generation and manipulation of data than from the fabrication of material goods.

In manufacturing, computers and computer driven equipment are already playing an ever more important role on the factory floor, while white collar "front office" work—information handling—expands enormously. In the service areas, both in private and public enterprises, developments such as minicomputers, word processors, automatic equipment, all linked by extensive telephone and satellite networks, are revamping the very way workplaces are designed and jobs themselves are defined.



Adapting to this revolution presents organized labor with one of its greatest challenges in decades. On the one hand, the new developments are too massive and extensive to even think of trying to stop in their entirety. Besides, many are necessary for improving American productivity at a time when economic growth has been very sluggish. On the other hand, present throughout is unprecedented opportunity for excessive management domination and control, through detailed monitoring of computer systems, as well as a very real possibility of economic growth (business growth) occuring in the face of growing unemployment. Such is the enormous capacity of integrated computer systems, a goal of many businesses here and abroad.

These changes are not limited to the United States. Similar problems are being faced in every major industrial nation. They directly affect professional and technical employees, who find themselves on the frontiers of innovation. On the assumption that we have much to share and learn from one another, and in our continuing efforts to try to understand and deal with problems generated by technological change, we present this report on some of the activities and thoughts of our colleagues in several European countries.

We begin with three long chapters describing in some detail pertinent background from three countries—Sweden, West Germany and the United Kingdom. The material presented here is based in part on the results of discussions between European trade unionists, government officials and management representatives and a delegation from affiliated unions of the Department for Professional Employees, AFL-CIO, headed by Rodney A. Bower, President of the International Federation of Professional and Technical Engineers. These meetings were held in the respective countries during October, 1980 (see Appendix). Also included in this report is a brief description of the technology steward system being developed in Norway. The final chapter, titled "Discussion", presents an analysis of the European situation, and some conclusions and implications relevant to the American scene.

Technological change issues have been growing in importance yearly. We hope that this publication offers useful information about what others are doing, and stimulates further fruitful discussion here in the United States.

I would like to close by offering our grateful thanks to the German Marshall Fund of the United States, who generously supported the European study tour referred to above, as well as the publication of this report.

Dennis Chamot
Assistant Director
Department for
Professional Employees, AFL-CIO

March, 1981
Washington, D.C.

Sweden

Sweden is a small, fairly homogeneous country. Most of its population of just over 8,000,000 is urban, and concentrated in the southern part of the country. The workforce of about 4,000,000 people is highly literate, and highly skilled.

Sweden's industrial origins can be traced back two to three hundred years, when the first exploitation of its natural resources of copper, iron ore, and lumber took place. Although these origins formed the bases for strong modern industries, the Swedes claim several key inventions propelled their relatively poor, rural society into the midst of the industrialized world of the 20th Century:

- Ball bearings
- Hydraulic separator
- Telephone
- Electronics.

Sweden's international and highly respected automobile manufacturer, Volvo, originated in the ball bearing industry, while the hydraulic separator formed the basis for an extensive machinery industry. Alexander Graham Bell notwithstanding, the telephone was "invented" in Sweden at about the same time as in the United States, leading to the development of an industry as important in Sweden today as it is in the United States. Electronics, in its early forms in communications equipment, rectifiers, and electrical power generation and transmission equipment formed the basis for what is today Sweden's largest and most dynamic industrial sector, engineering (machinery and construction) which currently accounts for roughly one-third of the country's industrial output and one-half of the total value of its exports. Sweden's well-known neutrality during the two World Wars forced the development of their own airplane manufacturing industry, SAAB. Neutrality also allowed Sweden to come through the wars with its industrial base intact and ready to take its place in the post-war industrialized world.

Sweden, however successful in its industrial development, is a world economy and is subject to the vagaries of world economic fluctuations. As a country dependent on exporting to Europe and the rest of the world about 40 percent of industrial production to survive, it cannot limit its imports, which amount to about 40 percent of its needs. As a result, its automobile industry is suffering from an onslaught of Japanese imports. Its heavy machinery industry is under attack by other European countries and the United States. And one of its earliest and most basic industries, lumber and pulp and paper, is facing heavy competition from U.S. and Canadian interests.

The world-wide economic recession generated by the increased prices of Arab oil is responsible for the worst disruptions in Sweden's economy. In maintaining full employment as a government policy, economic decisions were made based on assumptions that the recession would be short-lived. When this did not occur, a three-pronged attack was tried to regain Sweden's position in the world economy—a currency devaluation designed to make exports more competitive, increased taxation through the use of a value added tax, and the severing of connections with the European currency block. Swedish trade unions, as a whole, cooperated by moderating wage demands during these years. As a result, Sweden was able to regain its position in the world economy, recording a trade surplus and a halving of their rate of inflation.

An organized labor movement in Sweden dates to 1846 with the establishment of the Typographical Association in Stockholm. Development was slow, and stifled at almost every turn by employers until 1880 when the first real trade unions formed along craft lines. The formation of the Swedish Trade Union Confederation (LO) and the Social Democratic Party can also be traced to this period. The labor/management relationship reached a more advanced stage in the early 1900's with the formation of the first employer group, SAF, the Swedish Employer's Federation. The government in general left the employees' and employers' associations free to negotiate among themselves, and the two groups gradually came to recognize each other as equal parties at the bargaining table.

Labor laws began to develop in the 1920's. A Collective Contracts Act was passed that set in law the rights and obligations of each party to the other and outlined general provisions relating to working conditions. Also established at this time was a Labor Court to which disputes over collective bargaining agreements were to be taken for resolution before any industrial actions were resorted to. The Labor Court has seen varying amounts of activity since its formation and has developed a large body of precedents. These form very efficient guidelines for labor/management interaction leading to the resolution of many disputes before they advance to the Labor Court itself.

The 1930's saw the first formation of white collar unions in Sweden completely independent of the LO. Where blue collar workers had organized along craft lines some 50 years earlier, white collar unions developed from the extension of professional and social organizations.

Two associations formed by early white collar unions merged in the 1940's to form the Central Organization for Salaried Employees (TCO). One other white collar union association exists in Sweden, the Swedish Confederation of Professional Associations/National Federation of Civil Servants (SACO/SR). This group describes itself as a central professional organization for university graduates and salaried employees with higher education, and draws its membership 50 percent from state government employees, 26 percent from local government employees, 20 percent from private industry employees, and 4 percent from self-employed professionals.

In 1911, the craft unions in the LO voluntarily decided to reorganize themselves along industry lines. The basis for this decision was to avoid interunion competition and jurisdictional problems that could have resulted from several different craft unions representing workers in one industry. There are only a few unions left in Sweden which are organized along craft lines.

Labor legislation saw significant advances during the 44 year rule of the union backed Social Democratic party in Sweden:

- The Vacation Act allows every employee five weeks vacation minimum per year;
- The Act on Working Hours stipulates a 40-hour maximum work week and limits overtime per employee to 150 hours per year;
- The Security of Employment Act greatly limits the ability of employers to fire employees;
- The Promotion of Employment Act requires employers to notify county labor boards of any planned cutbacks involving five or more workers;
- The Shop Stewards Act strengthens the position of union representatives by forbidding discrimination against shop stewards, giving them superseniority in layoff situations, and allowing them unlimited leave of absence rights for union activities;
- The Board Representation Act allows workers in firms larger than 25 employees to elect two representatives to the board of directors of the company, with full participation in the decisions of the board; and
- The Joint Regulation of Working Life Act guarantees the union full information about the company, gives the union a right to approve organization of work and work assignments, in addition to hiring and firing of employees, and allows the union to veto subcontracting of work by the employer.

Labor legislation in Sweden is supplemented by a body of social welfare legislation without equal anywhere in the world. For example, childcare is provided free; public education, including school supplies and meals, are free; health care is free with minor exceptions; senior citizens are provided with pensions indexed to the cost of living and housing subsidies; and the handicapped are provided assistance in locating employment while employers are subsidized to hire and train the occupationally disadvantaged.

The welfare state of Sweden is certainly not without its attendant costs. Personal income tax is high, with marginal increases in income taxed near 80 percent. The social costs of alcoholism are paid through extremely heavy levies on alcoholic beverages. The same is true for the health costs of smoking tobacco. Average Swedes, however, look upon their system as the best in the world, and considering the advances made in human welfare in Sweden, they have a lot to be proud of.

Labor

The Central Organization for Salaried Employees (TCO) and the Swedish Trade Union Confederation (LO) present fairly similar views on the problems facing labor in Sweden today. Their views are similar until the question of technological change is presented. (The Swedish Confederation of Professional Associations/National Federation of Civil Servants (SACO/SR) has had little interest in the issues surrounding technological change.)

The TCO is an umbrella organization that is comprised of 24 affiliated trade unions with a total membership of over one million persons. TCO affiliated unions organize all sectors of white collar employees and at almost all levels. A slight majority of its members are female and TCO can claim some 60 to 70 percent of all organizable salaried workers in Sweden. Since TCO is a decentralized federation, most responsibilities fall to its affiliated unions. Collective bargaining, for example, is a responsibility left to the constituent unions while the TCO functions primarily as a coordinating and informational agency. TCO is also a nonpolitical organization but can and does exert its influence in political circles for the benefit of its membership.

To enhance its influence in collective bargaining, the TCO has formed cartels with other employee federations in the three sectors of the Swedish economy—the private sector, the state sector, and the local government sector. One of these, with the private sector constituent unions of SACO/SR, is the Private Salaried Staffs' Cartel (PTK). These cartels, moreover, bargain with different employer federations in each sector. The net result of the formation of these bargaining cartels is that Swedish employers have had to face a united labor front in most of their collective bargaining.

TCO is becoming increasingly involved with technological change and its effects on workers and worklife. Concern over these effects can be traced to 1970 when, for the first time, information gathered in the Swedish five year census was to be recorded on a computer-based medium. Questions raised at that time dealt with integrity—how the information gathered would be used and how it would be safeguarded from unscrupulous interests—rather than the effects of the medium itself on workers. These concerns resulted in

L. to R.: Dennis Chamot, DPE, Lennart Bodström, President of TCO, and Rodney Bower, IFPTE.

strict government regulations designed to maintain the privacy of any information gathered and stored in computerized data bases.

During 1975-76, Swedish white collar trade unions began discussions about the effects of computerization specifically on work, jobs, and employment. Accelerating over the last two years, these concerns have been fueled by statistical projections showing increasing unemployment due to the effects of technological change. Some 25 commissions consisting of labor, industry, and government representatives have been formed to conduct investigations of the potential effects.

Until the early 1970's, these trade unions had little interest in influencing policy, given the predominence of Social Democratic rule for the prior 40 years, and the close relationship between that party and the labor movement. The gradual weakening of Social Democratic power in their final years in office led to a resolution at the 1970 TCO Congress that, in the future, "work" should have the same influence as "capital" in the economic marketplace. This led to a series of worker participation oriented labor laws that started with employee representatives on company boards of directors in 1973, led to enhanced job security for wage earners in 1974, and culminated with the codetermination act of 1977.

This legislative base admittedly gives Swedish trade unions enormous protections, especially compared to American experience, but the law is not perfect. Although the union is entitled to any information the employer may have, there is no specified amount of time that the union must be informed before the implementation of changes. This has resulted in supplemental agreements in some instances to place time requirements on information, but not all employers have agreed to such conditions. An additional problem results from lack of knowledge about the effects of specific technological changes on the workplace. To alleviate this, a special fund has been established within the trade union movement to finance study of the effects of new technologies, although the trade unions recognize the vastly larger resources available to the companies to conduct studies in their own interests.

The job security law of 1974 effectively answers questions related to the retraining of displaced workers. In effect, the employer cannot fire a redundant employee, so he must make allowance for retraining. If the employee cannot adjust to the new technologies, the employer may fall back on the government labor market education program for the structurally unemployed. The Swedes attribute the high participation rates for this training to the payment of a wage to the worker while in the program. Indeed, the worker can remain in the program for a year or two, and if at the end of that time, suitable work is unavailable, the worker can enroll again in another area.

The TCO enumerates five sometimes conflicting strategies prevalent in Sweden for dealing with new technologies:

1. Make the introduction of new technologies more expensive to employers via new methods of taxation, such funds then to be used by the society in alleviating the problems resulting from new technologies;
2. Temporarily stop the introduction of all new technologies until studies of their impacts can be done;
3. Give local unions a veto power over the introduction of new technologies;
4. Enable the unions to be brought in at an early stage in the decision-making process on introducing new technologies;
5. Stimulate the introduction of new technologies to maintain Sweden's position in regard to international competition.

The TCO's own policy on technological change incorporates elements of all these strategies. Quoting the final report of their 1979 Congress:

> "Properly applied, technological advance can lay the foundations of social progress. Technological progress is a question of power. It must not be governed by an approach implying that man is gradually becoming a more and more superfluous appendage to machines. Computerization makes many routine jobs unnecessary, but it also generates many new ones. It is trade union members who have to do these jobs and be exposed to the physical and mental stresses involved by computerization. Trade unions must therefore be able to exert profound influence on the manner in which computerization is effected in Sweden."

LO, like the TCO, is an umbrella organization covering 25 individual Swedish trade unions. The oldest and largest of such confederations, LO's constituent unions have a combined membership of well over two million predominantly blue collar workers. This number represents over 80 percent of all organizable blue collar workers.

The LO, in contrast to the TCO, is a highly centralized confederation and may enter into the negotiations of any of its affiliates, providing guidance and suggestions for the solution of critical issues.

The LO, through the eight decades of its existence, has also been deeply involved in Swedish politics, maintaining close connections to the Social Democratic party. This relationship is directly responsible for the strength possessed by each of these organizations in Swedish society and politics and has allowed the LO a major role in the formation of much of the outstanding labor legislation that resulted from the 44 years of Social Democratic party rule.

Although two separate and distinct confederations, the LO and the TCO cooperate closely. This cooperation has become stronger in the last decade as both have become more involved in matters relating to structural changes in the Swedish economy. LO's aims, and indeed TCO's also, are to strive for a society based on political, social, and economic democracy for all workers.

One departure from commonality of interest between the LO and the TCO is in the area of technological change. Although they have studied the issue for the last 15 years, the LO still does not have much interest in the specific employment effects of technological change, preferring to rely on the overall Swedish policy of full employment to take care of any problems.

The LO believes that the Swedish economy is dynamic enough to continue to absorb an average of one million job changers each year as expansion in the service sector continues. The movement of this many people per year has not yet strained the Swedish social system. The society, in fact, has profited from this movement although the individual has not in all cases. Retraining of an average of 30,000 people per year, as provided under social welfare, has enabled relatively easy movement, although it is admitted that schools still train for occupations that are disappearing, since the choice of occupations is left freely to the student. In addition, there appears to be no conflict between unions due to people retraining for different jobs which may fall under the jurisdiction of different unions. To the LO, the important point is that people do indeed get other jobs.

L. to R. Anders Backstrom, LO Research Department and Clarence Robinson, BRAC

LO policy is a clear reflection of the view that society should not pay to keep people in disappearing jobs or pay to maintain skills that are dying in an increasingly modern world. The degree of Sweden's involvement in international competition is also reflected in the view that if a company must move its production facilities from Sweden to survive in world markets, it should do so rather than stay in Sweden and fail.

When an economy runs out of economic sectors to absorb excess workers, what then? There is a basic objection in Sweden to reducing hours of work to help increase employment. As a balancing factor, overtime work is not socially acceptable because no one wants to work it. Although vacation time continues to increase, this is more an indication of the importance of leisure time to the Swedes than a reaction to impending problems of technology. Retirement, at earlier and earlier ages, is receiving the most attention. With most persons covered under public pension schemes that are transferable between employers, retirement, although not early in the American sense, is viewed as the most acceptable means for increasing the total number of jobs in a shrinking market.

Codetermination is one of the most important achievements of labor organizations and Social Democratic government in Sweden. Yet for all the long history of labor/management cooperation, some Swedish unions are finding that the employers with whom they deal are working against the codetermination act (The Board of Representation Act), and contact with the Swedish Employer's Federation on these issues is becoming more and more difficult. In fact, there is wide-ranging pessimism among labor groups on even being able to approach employers for discussing the crucial issues of successfully implementing a plan for codetermination. Swedish employers, in the words of representatives of SIF, the largest white collar union, are beginning to look like U.S. employers, even to the point of using one of the most counterproductive of all the practices of U.S. employers—the services of anti-union consultants.

Falling back on the law is always a last resort, and it is always comforting to know that it is there to rely on if absolutely necessary, but this practice is not a positive one. The move away from the traditional cooperative posture is viewed as retrogressive, a step backwards in relation to all that has been achieved.

Government

As mentioned earlier, the current government in Sweden has been in power for only five years, following nearly four and one-half decades of Social Democratic rule. Policy differences between the two are quite apparent to a Swedish citizen, but they are less discernible to American visitors. While there may be less of a desire for creating new social programs today, and more of a concern for how older programs will be financed, there is no wholesale attempt to dismantle the remarkable structure constructed in the past. The importance placed on the impacts of technological change by the Swedish government is apparent when one notes that some 30 government commissions have been formed to investigate the potential problems arising from such changes.

The Computers and Electronics Commission of the Ministry of Industry, for example, is charged with conducting studies in two areas—the effects of computerization on engineering processes and the use of computers in data processing. Seeing that the engineering sector is the key to the future of Sweden in the world economy, this section of the commission is conducting the most wide-ranging studies. Its investigations have taken delegations to foreign countries, including the United States and Japan, to study the effects of automating manufacturing processes on employment, industry structure, productivity, etc.

Sweden has the largest number of industrial robots per capita in the world. Most of the robots used in Sweden are produced there, some 85 percent, while about 60 percent of the country's production of robots is being exported. There is presently little government concern over the effects of using robots in Sweden because the change to robotics is taking place very gradually.

Jan Carlsson, Secretary, Computers and Electronics Commission, Swedish Department of Industry

There had been rising concern over robotics among the Swedish trade unions due to studies produced by the U.S. National Science Foundation, General Electric, and Westinghouse. This feeling though seems to be changing with experience. Now the government sees a much smaller potential for robotics compared to original estimates. High costs, mechanical limitations, and slow speeds of existing robots is changing the opinions of Swedish industry as to their usefulness, at least for the present. The design of products has a much greater effect on the successful automation of production processes than the use of automation in the production process itself, even though the result on labor is essentially the same. In any case, studies in these areas are continuing.

The work of the Commission on the Effects of Computerization on Employment and Working Environment of the Ministry of Labor raised an important point that changed slightly the direction of their work. Charged with answering a quantitative question, how many jobs will there be, where will they be, and what will they involve, the commission has come to the realization that the question may well be impossible to answer definitively, especially as the technology changes rapidly.

The study being performed by the commission will concentrate on the combined effect of production and productivity on jobs. In the 1970's, working hours decreased while employment increased. This was caused by the addition of a (legislated) fifth week of vacation and increased educational leave made available to workers. Productivity increased and production increased during this time. Using this situation as a model, the commission will use a methodological view of the best way to calculate employment changes given changes in technology. Although realizing that models based on past performance tend not to be applicable to new situations, the commission considers this the most logical path to follow in trying to determine the quantitative effects of technological change.

In many ways, this dependence on academic, macroeconomic modeling techniques points to similarities of approach to American government planners. The results will probably be just as useful. Still, one gets the impression that the Swedish government, far more than the U.S., is committed to extensive study of potential human impacts of changing technology, and to social action, wherever warranted, to help people adjust to those changes.

A further example of the commitment of the Swedith government to issues of concern to labor is the fact that public funds wholly finance the work of the Swedish Center for Working Life. Established in connection with the codetermination act of 1977, the center functions as a research institute for industrial relations and other worklife problems. Not a government agency, *per se,* the staff of the center have a fair amount of independence. They are dedicated to the enhancement of knowledge on all aspects of working life, and to increased influence of all employees, including all aspects of codetermination.

There are currently several studies underway at the center dealing with the positive and negative aspects of technological change in various industries. For example, one study finds that the banking industry is on the verge of great changes in its methods of operation in Sweden. These changes show a heavy concentration on technology, with the widespread application of computerization to all levels of work within the industry. Automated systems could potentially eliminate about one-third of the current banking staff in Sweden in the next 10 years, with these effects concentrated in the front office—tellers and savings personnel—and the almost complete elimination of routine back office work.

Technological changes center on data processing, terminal systems, automatic teller machines, word processing, and personal computing (the performance of computation and analysis by customers themselves rather than bank personnel). Although bank management foresees a maintained level of employment in the decade of the 1980's, this study is in direct conflict, citing a combination of the potential for reorganization, branch office shutdowns and mergers, a relatively stagnant economy, and few new ideas and products.

Where declines are anticipated in lower level employment categories, increases are expected in such areas as economic advisors, analysts, calculation and data processing personnel. The wide gap between the types of personnel affected point to increased training problems and doubts that there will be transfer of many employees from one group to another. It is expected that turnover will account for some of the drop in employment, especially if changes are implemented in a fashion that effectively makes use of normal attrition. However it is expected that reducing hours to spread employment opportunities may have to become acceptable in the banking industry.

Technological change has already affected the printing and publishing industry in Sweden, creating growing conflicts between graphic arts workers and journalists. As is becoming common in the United States, video display terminals are starting to replace journalists' typewriters in Sweden, effectively eliminating the typesetting phase of the printing process. Their introduction met some resistance at first by some journalists, and the use of VDT's was thus not required. This attitude however, was easily circumvented in the hiring process, as newer, younger entrants into the field were introduced to them at the start.

A decline in the quality of journalism has been noticed with the introduction of VDT technology, not in the artistic quality of journalism but in the technical quality. It seems that management, upon the introduction of VDT's to the industry, eliminated proofreaders, requiring journalists to do not only their own typing, but their own proofreading as well, with predictable results. With graphic arts workers removed from the proofreading process, management then hired secretaries to do final typing and proofing of copy, at much lower wages.

This industry is the sole example of a collective bargaining agreement on technological change existing in Sweden at the present time. It provides minimal protection by itself but is significant nonetheless. It states simply that when technology is introduced that displaces graphical arts workers, they have a right to be retrained for jobs within the industry rather than having to rely on the general retraining provisions of the Swedish social welfare legislation.

As one last example, the Center's study of the Swedish insurance industry shows its now almost total conversion to the use of new technologies. The insurance workers union has a membership near 20,000. Employment in the industry doubled in the 1970's reaching 17,400 at the end of the decade, although this might have been some 4,000 higher if new technologies had not been introduced, the study finds.

New technology in the industry has been in the form of VDT's and the computerization of records. Qualitatively, the use of this new technology has been seen to lead to a decline of the membership's knowledge about the industry and the work they do. Fragmentation of the work has probably led to decreases in the quality of service provided by the industry. Further, VDT use does result in eye and neck problems, headaches, and increased stress. Collective agreements have limited intensive VDT use in this industry to one hour in duration, twice a day. In addition, eye examinations and eye glasses are to be provided by the employer if needed by employees working on VDT's.

The insurance industry has been involved in some unique experiments in worker education in Sweden. State sponsored study circles, where workers participate in educational sessions designed to increase their awareness of factors affecting their jobs and industry, have been attended by over half the membership of the insurance workers, and with excellent results.

The limit of local union influence on technological development is a problem in Sweden and efforts are being made to increase this influence. The work of the Swedish Center for Working Life is centered on how the local and national levels of unions, each with their own spheres of influence, could better work together to solve the problems of new technologies.

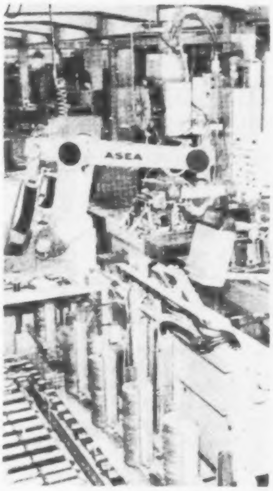
Industry

An American whose knowledge of the Swedish system is limited to what is presented in American magazines and newspapers could easily conclude that there are no real differences between Swedish unions and employers. We frequently hear of the establishment of progressive social programs, or experimentation with worker control of production, for example. However, while the relationship between Swedish unions and employers generally appears to be much smoother than is the case in the United States, conflicts do arise.

Introduction of new technology is one area where these differences come to the surface. Ultimately, they derive from the goals to be met from control of the workplace, and these goals are inherently different—higher profits and greater managerial flexibility for the employer, versus higher wages and more humane working conditions for the employees.

It may be instructive to look more closely at a couple of individual companies, one a private employer and the other public. One should keep in mind the very high rate of organization in Sweden (including many people in middle management positions), as well as the extensive labor laws mentioned earlier.

First, ASEA, in some ways the Swedish equivalent of General Electric. ASEA is a major force in Sweden and extends to 15 other countries around the world (including the United States). In 1979, the company had worldwide sales of nearly $3 billion and employed over 43,000 persons in all of its operations.



Industrial robot in operation in ASEA plant.

At the Electronics Division of ASEA, office operations are undergoing automation, involving word processing, data processing, and other computer related techniques. The start of automation of the office environment began in Sweden in the mid-1950's with the use of punched paper tape input to computerized data processing equipment. This progressed to the use of magnetic tape, then magnetic cards, to cassette tape input, to the current use of disk storage systems for data, word, and text processing. This most recent change, according to management, had come about with little resistance from employees, who were said to have welcomed the new equipment. A small amount of hesitance was encountered at first but peer pressure brought those resisting around to accepting the new equipment.

Although the new office equipment easily allows management to compile data on the productivity of individual employees using the equipment, management denies using this feature on an individual basis which would be a violation of the Swedish computer law. Groups of employees were said to be monitored but only to rate the effectiveness of the new equipment. Ergonomics, the study of machine design and human/machine interactions, was considered when planning for new office equipment, with such factors as screen glare, hand rests, movable VDT screens, and printer noise being determinants of the equipment finally chosen.

Although all indications from management were that the new equipment was heartily accepted by employees, it was later learned that resistance varying from serious to extreme, including wildcat strikes by production employees, was encountered upon the installation of the equipment. Consultation with union representatives was said to have been minimal—no more than that required by the various pieces of labor legislation in effect.

ASEA has also established a centralized computer center, a very high security installation in which the computers directing all of ASEA's operations are housed. ASEA uses computers for technical simulation, design automation, product inventory, marketing and sales records, accounting and personnel records, office automation, and plant automation and testing. Their computing facilities are all centralized into this one center, raising concerns of security and explaining the security check needed to enter the building.

ASEA considers training in the use of computerized systems crucial to the successful implementation of such systems. There apparently is no training arranged by the union, although there is labor/management cooperation on the issue of training. The general attitude on the part of the union seems to have been that of falling back on labor legislation to deal with potential problems. This may be due to the fact that large numbers of employees have not yet been significantly affected by new technologies since demand and production continue to rise. However both sides admit that problems are likely to arise when and if demand for products and services levels out.

In addition to the actual computer center housed in this building, much of ASEA's computer programming and systems analysis is done here. Programmers and analysts work at VDT's that are manufactured in Sweden and in the United States by IBM. An interesting comparison can be made between the different types of VDT's, those from the U.S. having green screens with lighter green characters and a minimum of adjustments, while the Swedish models were fully adjustable with a minimum of screen glare and easier to read yellow characters on a dark brown screen.

The company is also actively developing new technology for computer-aided design. It is claimed that 40 to 60 percent of the time previously devoted to project and circuit design has been saved through the use of computers.

For example, computer-aided design equipment can be used by drafters to design electronic circuitry diagrams. The designs being drafted are originally devised by engineers and roughly sketched-out by hand. This basic design is then given to the drafter to develop the final diagram using computer assisted equipment. This equipment recalls from memory individual circuit symbols and places them in any orientation and at any size on a circuit diagram displayed on a VDT. Diagrams are built-up until complete and then automatically printed.

ASEA management claims that even though roughly 50 percent of the circuit design operation is still done by hand in making and refining the rough circuitry sketch before finalization on the computer, within five years the entire operation may be performed by the engineers themselves, using their own terminals, and eliminating the drafters' current involvement in the process.

The A.C. Machine Division of ASEA produces small and medium electric motors, generators, convertors, and electromagnetic disc brakes. A large number of numerically controlled machines and industrial robots are used on the facility's production line. The industrial robots on the line are relegated to performing tasks that were considered dangerous to humans or extremely boring. For example, aluminum casting and high pressure stamping operations that each had previously required about four persons were now being performed by robots, one per operation, with four robots being attended by only one person. Whether the job of tending to the needs of industrial robots is routine or not is arguable, but it is clear that humans are being removed from production areas where their health and safety were clearly endangered. Coincident with this is the overall reduction of the number of people needed for a given level of production.

Other robots on the production line perform routine machining and assembly operations. One, for example, drills a series of six holes in brake housing castings, a slow operation where the robot picks up undrilled castings from an area behind itself, turns around, places the casting on a drill press for the drilling of three holes, picks up the casting, turns it over, places it in another drill press for drilling three holes on the other side, picks it up, clears off metal scrap with compressed air and places it in a pile of finished castings. The entire operation takes several minutes to complete, apparently due to the mechanical limitations of the machine. A human probably could have accomplished the task in less time, but the monotony of the operation, somewhat exaggerated by the slow movement of the machine, is apparent. This machine is in constant service, 24 hours a day, and requires only minimal maintenance. The only recurring need for human attention is for supplying it with undrilled castings.

In later discussions with production management, it became clear that the introduction of robots and other automated equipment was not done solely for humanitarian reasons. (Safeguarding the physical well being of their employees does seem to be a real concern of Swedish management, whether because of legal consideration, union influence, or social pressures, or a combination of the three.) High wage levels in Sweden was certainly a major factor leading to the initial decision to utilize numerically controlled machines and robots.

This decision was at first resisted by the union. However, the machinery became accepted when it seemed that without it, the facility in question might have had to close because of its lack of ability to compete in both domestic and international markets. Without the automation that had thus far occurred, this plant would have employed about twice as many people as the nearly 700 it does now. As it is, production doubled in ten years, with a stable workforce.

Televerket

In most civilized countries, one would expect the relationship between union and management in government agencies to be particularly good. This appears to be the case in Sweden, at least as demonstrated by the telephone company.

Televerket (TVT) is a government-owned monopoly which otherwise resembles the U.S. Bell System. It is a fully integrated company both vertically and horizontally, that provides service in 20 geographic areas covering the whole of Sweden. In addition to equipment and basic telephone service, TVT provides data communications, text communications, telefax and advanced business equipment and services. TVT has no competition in the provision of telephone service but it does maintain a subsidiary operation that provides alarm signalling service in competition with private companies. The provision of facilities for radio and television services is also within its province. TVT employs over 43,000 persons and has the equivalent of some $8 billion invested in its network.

Unlike the Bell System, TVT and the unions covering its employees (there are three) are closely cooperative, maintaining an open dialogue on all matters mutually affecting them. To maintain a position in the forefront of telecommunications technology requires such a utility to be constantly changing and updating its equipment. All such changes, how they will be implemented, and how their employment and occupational effects will be handled are subject to negotiation and agreement between the utility and its unions.

Technologically speaking, TVT is currently some five to ten years behind the Bell System in its development. Where the Bell System claimed a fully automatic dial system in the early 1960's, TVT achieved that goal in 1972. TVT is just now beginning to implement electronic switching equipment (fully digital) and predicts its completion in ten years. The Bell System began this process in 1965 and is now over 30 percent complete, although very little of its equipment is digitally controlled. The gap between development of the two systems is narrowing. The future plans of each are quite similar—fiber optic communications systems, large scale integrated circuitry, increasing data communications capabilities, etc. One point of departure is Sweden's (indeed, most of Europe's) interest in developing Videotext communications. This two-way interactive video communications method uses the telephone network for information transmission and is close to implementation in Sweden, as it is in the United Kingdom, France, and West Germany.

Given the increasing use of new computer technology exemplified by VDT's, concerns are running high over the health and safety of workers exposed to them at TVT. Internal studies have uncovered problems such as apprehension, eye strain, neck and back strain, monotony, and fear and negativistic attitudes from the use of VDT's. Such problems have led to agreements whereby work on VDT's is limited to two hours per session, twice a day, with at least two hours break between sessions. Employees are also entitled to free eye examinations and corrective glasses if their work involves the use of VDT's. The utility claims that if it could safely have people working only two more hours per day on VDT's, the cost of the terminal itself could be doubled and still be cost effective. This is certainly an incentive for doing much more research on the design of VDT's. Their major problem in this regard however, is that they import almost all their terminal equipment from the United States where less emphasis has been placed on operator comfort.

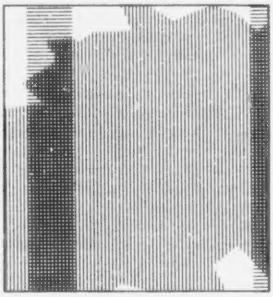
The labor/management relationship at TVT, thanks to labor legislation and overall concern for the human being, appears to be excellent. Local trade unions are entitled to consultation and agreement on any new programs initiated by the utility, and as a rule, are involved in decision-making from the start. Their major influence has been on the way work is done at TVT. Changes here take the following form:

1. Union/management agreement to study a potential change;
2. Prestudy of change is performed;
3. Union/management agreement on direction to take in implementing change given results of prestudy;
4. Development of change is studied to determine its goals and objectives;
5. Union/management agreement to implement change; and
6. Change is implemented along agreed lines.

Every step of this process is open to the unions involved. Since this process resulted from the 1977 codetermination act, it is still somewhat experimental. If agreement cannot be reached in any of the above steps, the utility has the right to make the final decision; however, discussions may always move to a higher level, and ultimately, to the Swedish Labor Court.

The main point is that in all Swedish companies, the decision to install new technology is, in fact, still a unilateral decision of management. Codetermination in Sweden is still in its infancy, and has not changed this basic situation. Swedish law and custom goes against routine layoffs, but questions of changing work content and structure are still very much areas of concern to the unions. At the local level, where these questions are often encountered, the unions have not always been able to match the expertise and planning resources of management. This is an area of major current activity within the Swedish trade unions.

Federal Republic of Germany



West Germany, although tracing its cultural origins well back into history, politically entered the modern world on May 23, 1949 when the Federal Republic of Germany was created from the ruins of World War II. Although only four years after the official end of the War, the country was in a favorable position for rapid development, as many bonds were forged during that time with the international forces occupying the territory, assuring its transition to a democratic state.

The West German economy has developed into one of the strongest in the world since the end of the war. Relying on its own natural resources, including the resourcefulness of people, it has become a world leader in metal production and processing, motor vehicles and chemicals. Its major industries are facing, and meeting to a large extent, onslaughts of inexpensive foreign products. Deriving a large part of its GNP from the export of its products it cannot place limits on its imports and still expect to be competitive in world markets. West Germany is relying on traditionally high rates of productivity and the quality of its products to meet this challenge.

West Germany, like Sweden, has accumulated an impressive body of social welfare and labor legislation. Although the tradition and spirit of this legislation goes back to late in the last century, most has been revised and amended since the formation of the Republic. In the area of social insurance, West Germany can claim the following:

- Unemployment insurance financed by a three percent payroll tax shared by the employer and the employee that pays up to 68 percent of previous net earnings, plus family allowances;
- Health insurance financed by a payroll tax of 12 percent shared by employer and employee, that pays full gross earnings for the first six weeks and 65 to 75 percent thereafter up to a maximum of 72 weeks, and includes free medical and dental care, and hospitalization and medicines at nominal fees;
- Accident insurance paid for by employers only, that covers all paid employees, farmers and family helpers, school children, and students; and
- Old age, disability, and survivor's insurance financed by a payroll tax amounting to 18 percent of earnings up to about $2,500 monthly, and shared by employer and employee. Pensions, as paid under this insurance, start generally at age 65 and cover some 65 percent of net earnings.

Labor legislation in the Federal Republic of Germany clearly revolves around the concept of codetermination, which can be traced to the revolution of 1918 and workers' demands for a voice in management. A works council act of 1920 gave workers minority representation on boards of directors but this right was abolished by Hitler. The concept was restored by the occupying allied powers after the war and since that time, legislation has confirmed the concept of works councils and expanded workers' rights under codetermination.

In its modern incarnation, West German codetermination results from three separate legislative acts:

- The 1951 Law on Codetermination in the Coal and Steel Industries mandates that on the boards of directors of these companies, representation will be 50 percent for the stockholders and 50 percent for the employees;
- The Codetermination Law of 1976 mandates that companies with more than 2,000 employees operated as stockholders companies must give their employees equal representation on the board of directors;
- The 1951 Industrial Relations Act (amended in 1972) gives employees of companies not covered by the other two aforementioned acts the right to one-third representation on the board of directors.

Public employees are guaranteed their own, rather limited form of codetermination by the 1974 revision of the 1955 Personnel Representation Act which establishes joint labor/management Personnel Councils that concern themselves primarily with working conditions and social issues as they relate to public workers.

Codetermination, although complex in its legal underpinnings, revolves around a very simple concept—"participation—a human and economic need" to quote a major West German industrialist, Social Democratic party representative in the Bundestag, and owner of Europe's largest producer of ceramics.

A worker's voice in running a company is just one aspect of the West German form of co-determination. It also involves capital sharing, an aspect not nearly so well developed, or subject to as many legal reinforcements, but again simple in concept. Worker ownership of shares and investment certificates of the company will inevitably lead to the worker profiting from his labors more than in the form of increased paychecks. It can also lead to a lower rate of absenteeism, and a high degree of personal interest in cooperation and productivity improvement, it is believed.

A major aspect of codetermination in West Germany is the establishment of the works council at the shop floor level of every business in West Germany. The works council has legal foundation in the Industrial Relations Act of 1972, which requires the election of a works council every three years by the workers of any enterprise employing five or more persons. Quoting the law:

> "The employer and the works council shall work together for the good of the employees and of the establishment in cooperation with the trade unions and employer's associations "

The works council's membership varies according to the size of the establishment. Men and women have proportionate representation and youths are also represented. Establishments larger than 3,000 employees may have as many as 13 full-time works council members earning their full pay while performing council business. Works councils do not negotiate agreements as such, but have a voice on local issues such as:

- Hiring and firing policies;
- Training, and health and safety issues;
- Job evaluation, wage rates and structures;
- Working hours and schedules; and
- Issues affecting employment, such as technological change, displacement, retraining, worker welfare, etc.

The works councils should not be confused with American-style union locals. The membership of the works councils are elected by all the various groups of employees in each establishment, white collar and blue, to represent them with the employer. These councils are formally and legally independent of the national unions. On average, about one-fifth of their members are not members of any union.

Collective bargaining itself has reached quite advanced levels in West Germany. Bargaining, with a few exceptions, takes place on a regional level between a national trade union and an employer association. The resulting industry-wide standards specify wage increases and working conditions for union members which are generally adopted by firms in the same industry that are not unionized. Indeed, public acceptance of collective bargaining in West Germany is so high that non-union workers in an establishment generally want the same settlement applied to them even though, by German law, a collective agreement can be binding only upon the union members of such an establishment.

The importance of collective agreements in West Germany is further emphasized by the fact that some 8,000 are negotiated every year. The unions themselves have, in addition to the right to negotiate agreements, the ability to form coalitions among themselves for additional strength in bargaining. They also have the right to strike at any time that an agreement is not in effect, such as after negotiation deadlines have passed. However, if an agreement expires or is terminated, its conditions remain in effect until a new agreement is negotiated. In general, agreements are made on a regional basis although some companies that are national in scope negotiate national agreements covering all operating units of the company.

In general there are two types of employer lockouts used in West Germany —as a reaction to a union strike, and as an employer action that takes place on a regional or national basis. The first type is apparently quite common, the second has seldom been used and generally only occurs in times of high labor unrest. Lockouts of any type have lasted from less than one day to up to six weeks in a particularly widespread disagreement in the printing and publishing industry. Just as there exists interunion support during strikes and lockouts, there is some coordination of employer support during these times also. Employers have established a fund to help support companies that are in the midst of a strike or lockout. Additionally, as a strike fighting measure, West German employers will attempt to mobilize non-union employees to take the place of striking workers.

Rather than a federally administered mediation service to handle disputes, the parties to a contract have developed their own voluntary, jointly administered conciliation system. Disputes resolveable through this system may go through three levels of labor courts functioning on local, regional, and federal levels.

Labor

Trade union membership in West Germany currently stands at over 40 percent of all organizable workers. Unions are organized along industry lines with the largest being IG Metall, counting over 2.5 million members. Most West German trade unions are affiliated with the German Trade Union Federation (DGB), a federation of 17 industrial unions, comprising some eight million members.

The German Trade Union Federation (DGB) is very similar in structure to our AFL-CIO. It was founded in 1949, only a few months after the establishment of the Federal Republic itself. The DGB claims no direct political affiliations, however its history has been closely tied to that of the West German Social Democratic party and it is from this "partnership" that much of the Federal Republic's labor legislation has originated.

By the DGB's own estimates, the West Germans are approximately three to seven years behind the U.S. in implementing new technologies. Technological change in Germany, as in the rest of the industrialized world, centers on the use of microelectronics—flexible, cheap, and used everywhere from small to large companies. It has seen broad use in both public and private services with retail and wholesale trade being particularly affected. Its use has extended to management and administration, thus threatening the most classical of all white collar workers.

The DGB sees few new jobs opening up in public and private white collar employment and anticipates more jobs lost in this area than in factories. The use of microelectronics will spread even further as computer-aided design equipment becomes a threat to designers, drafters and engineers.

The resulting picture is not very optimistic. We may see large scale polarization in employment, with a small number of highly qualified jobs which will require intimate knowledge of the systems being used, and large numbers of simplified, low skill jobs, for which knowledge of computer systems is not necessary. The large group will see increases in physical stress and psychological strain, primarily with increasing use of VDT's, and the chances of workers losing control of their jobs will increase greatly with new technologies.

L. to R. Günter Friedrichs, Head Automation Department I G Metall, and Rodney Bower, IFPTE.

The DGB sees a need for active growth and industrial innovation, with a strong investment policy by the state. The current West German government has handed over to the unions and the companies the responsibility for developing change, effectively disengaging itself from the problem ". . . it is the task of the employers and unions to care." The DGB will not dismiss the government from the responsibilities it perceives it to have, and is actively working to increase government involvement in the handling of problems related to technological change.

Toward this end, the DGB has involved itself in stimulating public debate, and has made attempts to widen the scope of West German collective bargaining to establish a framework to regulate the introduction of new technologies. Under consideration for example, are advance notice of implementation, protections against dismissal due to the introduction of new technologies, protections against the tailorization of production to fit the new technologies, and protections against wage reductions. Also being considered are the potentials of work enlargement and enrichment without the usual stress and strain attendant to technological change.

In contrast to general opinion in Sweden, reduction of the work week as a means to increase available employment opportunities is well accepted in West Germany. Collective bargaining agreements at this point almost all have five day, 40-hour work weeks as a maximum, even though the federal wage and hour law still specifies a five and one-half day, 48-hour work week. Through collective bargaining, the West

Rodney Bower, IFPTE, and Günter Volkmar, President, HBV

German trade unions are attempting to lower the work week to five days and 35 hours (a four day week is not looked upon favorably) although there is no effort underway to have the wage and hour laws reduced to reflect the realities in practice.

Unions and the members they represent are beginning to experience difficulties brought about by technological developments. For example, the Commerce, Banking and Insurance Workers Union (HBV) has a total membership of about 350,000 persons, 85 percent of whom are white collar workers in private industry. The bulk of their membership is in the commercial sector, some 65 percent, with the remainder in banks (16 percent), the insurance industry (10 percent), and miscellaneous commercial services (9 percent). The HBV has major problems in effectively dealing with the problems brought about by technological change partly because such change in the banking and insurance industries is a relatively new occurrence in West Germany.

In banking, there are about 50,000 tellers, yet only some 300 have been affected by automatic teller machines. The HBV estimates that by the mid- to late-1980's, all 50,000 will have seen some of the effects. Banking employers have continually claimed that changes in technology are being made for the benefit of their customers, not to reduce employment at the banks, yet they admit that the new equipment will slow down employment growth, even in the face of expanding business. The insurance industry, too, is seeing technological changes, in the forms of word processing and data processing of customer records. These technologies are enabling reorganization in both industries that allow them to centralize their operations using only skeleton crews at regional locations.

The HBV sees the need for increased research, fearing that a great number of jobs will be lost and those remaining will have their qualifications greatly lowered. They have started to negotiate agreements attempting to deal with the situation but have not yet been fully successful, in great measure because of employer resistance and the low rate of organization in these industries in West Germany.

The HBV has achieved a good deal with the VDT issue, guaranteeing improved working conditions for VDT users, better training in the use of the technology, and health considerations such as eye checks and eyeglasses if necessary, paid for by the employer.

I G Metall, the Union of Metal Industry Workers, the largest of all West German Trade unions with over 2.6 million members, foresees many difficulties stemming from technological change, even though they have an Automation Department which has been functioning since 1960. Their studies pinpoint the problem of potentially increasing volume of business without similar growth of employment, a situation brought by the enormous productivity improvements possible because of technological developments.

Today, German productivity is increasing and production capability is increasing, but the rate of real growth is going down. With a one percent rate of GNP growth expected in 1981 and an increase in working population expected also, there is an anticipation of increased unemployment resulting from economic growth not large enough to compensate for labor force growth. In fact, this trend is expected to continue into the 1980's, doubling the rate of unemployment by 1985.

Job content is also changing. Skill levels, in general, seem to be decreasing, and IG Metall has won one concession in bargaining that will assure a long period of time for workers to be downgraded, with no decline in real income due to this downgrading. This resulted from a long and bitter strike that involved several hundred thousand workers over one-third of the country.

This approach offers some protection for affected employees, but does not solve the underlying problem.

I G Metall has achieved some contractual gains in the area of work organization with one agreement covering over 800,000 workers in heavy industry in one region of the country. This agreement deals with the division of work and disallows the creation of any new job that takes less than one and one-half minutes to perform. This is considered the first big step toward trade union control over division of work in West German industry. This agreement also provided some other protections—persons older than 54 cannot be fired or downgraded and workers on piece rate pay systems get an eight minute break per hour. These provisions are all minimums and subject to improvement at the local level.

On the use of industrial robots, the experience in West Germany is similar to that in Sweden—one robot can replace four human workers while creating one job for the maintenance of the robots. This one job, although in many cases much safer to perform than the four eliminated, is likely to be much poorer in content than those replaced. The trade unions in West Germany, through codetermination, have the opportunity to influence the development of robotized processes but don't always have the specialized knowledge that would be necessary to make a meaningful contribution to this development. Government money for conducting research is forthcoming, but the building of expertise is a slow process.

Caspar von Stosch, Head, White Collar Workers Department, DGB

One strategy that has been used with a good deal of success is publicizing the issues and engendering public debate. In the early 1960's I G Metall sponsored its first conference on technological change. The American House in West Germany offered the services of four U.S. automation specialists to develop and discuss the impacts of technology. This effort was moderately successful in bringing the issue out for discussion among the workers and the general public. The following year saw the publication in Der Spiegel (the German equivalent of Time Magazine) of a cover story about new technologies and their effects on workers and working life. The year after that saw the second international conference on technology that lead to funding by the German government of over 40 individual case studies of technological change in West German industry. The third conference in 1972 led to the first collective agreement covering the effects of technological change, a major breakthrough that eventually was adopted by over 70 percent of German industry.

While German unions are not fully satisfied with codetermination legislation, the system has been helpful. The advance notice possibilities of the law can be particularly useful, with the union often knowing the development plans of a company before the company's stockholders. This effectively translates to at least one year's advance notice.

Codetermination also leads to essentially continuous bargaining between unions and employers. Each year in January or February, new rounds of negotiations open on the subjects of wages and working conditions. However, with works council agreement required on most issues, negotiation continues almost all the time. This allows for the resolution of many difficulties before they develop into full scale conflicts.

Research

The Ministry of Technology and Research (BMFT) is a federal level agency of the West German government that is charged with promoting the development of new technology in the West German economy while conducting or promoting studies in humanization research on the effects of new technologies. The BMFT has a total budget of over $3 billion per year. The section conducting humanization research began in 1974 at the same time the codetermination act became law in West Germany. The two subjects are considered very closely related.

A major part of this department's funding (about 50 percent) is distributed directly to industry and used by them to conduct studies to humanize the work environments found in their facilities. For example, a recent experiment was conducted at Volkswagen to develop a process to do away with the assembly line method of automobile manufacture. About $60 million was contributed to this experiment by the BMFT, an amount that was matched by Volkswagen. Additional subcontracts were let for psychological, ergonomic and organizational research studies for the primary project. The results of this experiment, although moderately successful, were not adopted by Volkswagen. This, however, is not considered a failure by the BMFT, as valuable information developed from this experiment that can be transferred to other projects in the future.

Any projects in the humanization area which are funded by the BMFT must receive the approval of the works council in the location the project will take place. In addition, labor input is gathered through the use of tripartite internal commission consisting of labor, management, and government representatives which acts in consultation on projects that are taking place. If workers are not be be directly affected by a planned project, their consultation and agreement are not a requirement.

Research projects being undertaken currently strive for a broadening of a particular project's impacts. Studies are now directed at humanizing an entire plant, rather than only one section of a plant. In a plant where the assembly line is the primary focal point of such a study, the whole plant, including the office work places of such a plant, will have to be included in the study and will be expected to benefit from the results.

The BMFT also funds much basic research on health and safety issues, such as cancer-causing effects of asbestos and the design of equipment to enhance worker safety. In addition, funding is targeted for studies in the more insidious forms of worker hazards, i.e. VDT's and their ergonomic considerations, and the effects of high levels of noise on workers.

The VDT issue provides an example of the power of local works councils. Should a company install VDT's that are not manufactured to the standards expected by the works council of the plant, the works council can direct employees not to work at those VDT's. This in turn forces the company to acquire different VDT's. Once a precedent like this has been established, unacceptable VDT's are not likely to be purchased by the majority of West German industry, and thus not likely to be produced.

Much of the work done by the BMFT has been in large industries with strong unions voicing their demands for the study of potential changes directed at humanization. This has led to an unfortunate neglect of industries without strong unions, such as textiles, woodworking, and restaurants. These industries generally have a few employees per establishment, bad working conditions, weak unions, and not particularly good representation. In fulfilling its mandate, the BMFT is expanding its work into these industries also.

Another section of the BMFT concentrates on research projects in data processing, communications, and electronics. This group has more of an industry/technology orientation than the group that was involved in humanization studies. One of this group's mandates is to promote the use and advancement of information technology. This group originated in the early 1970's in response to recognition in most parts of the industrialized world that the information age was the logical next step after industrialization. From 1971 to 1979, the group concentrated on raising West German information industries to the level of the rest of the world in data processing capabilities. This having been accomplished by the mid-1970's to a large extent, emphasis was placed on strengthening the competitiveness of West German manufacturers of information processing equipment. Work in this area is easing now that the industry is competitive in international markets.

The department sees its future in the development and promotion of the technologies of information processing and communications. These include digital and optical communication technologies. Teletext, Videotext, electronic funds transfer, electronic mail, and a German invention called Vidiumtext. Vidiumtext takes the limited two-way interactive capabilities of Videotext and expands them to communication and dialog with any other user, using only a television receiver (suitably modified) connectd to the telephone network. This system will undergo field trials in 1981.

As to the social impacts of technological changes at the workplace, the government itself is not of one mind. The Departmental Ministers all have different opinions, to some extent split along party lines – Social Democrats and Liberals – with the most extreme view being that government should do nothing, letting things work themselves out, with the possible exception of providing retraining programs. In other words, the government accepts the responsibility for assisting the development of technological resources of the society, but insists that the unions and companies must be responsible for the social system's development to handle the resultant problems.

As mentioned earlier, the unions do not accept this view. Industry, in consultation with, and with the tacit approval of, the trade unions has partially dealt with these problems by developing a method for continually reducing the average age of the workforce. Through the use of quite well-developed and accepted early retirement plans, many older workers are taking advantage of early retirement opportunities, leaving their jobs and allowing a younger workforce to take their place. At the age of 55 most workers can "retire" and earn supplemental pay for three years, they can then go on unemployment pay for one year and at age 58 or 59 can qualify for early retirement and earn their regular pension through the state supported schemes.

Meeting with bank officials in the Board Room of the Bank für Gemeinwirtschaft, Frankfort

Industry

Because of their heavy involvement in export, German industry is quite interested in the continuing development of manufacturing technology and office and computer systems. The trade unions are not as concerned as their American colleagues about the direct export of technology and manufacturing processes by the establishment of manufacturing plants in low wage countries, because German companies have found that processes involving high technology are not easily transferrable to these areas. Where this has been attempted, manufacturers are returning the work to West Germany. In addition, unlike American businesses, German companies are reluctant to take key technologies abroad because of fears of losing control of the processes.

Of more concern is the desire by all employers to use technological advances to halt employment growth within their own companies. This is not only true for manufacturing, but is also widely practiced in white collar areas such as banking and insurance.

For example, the West German Consumer Credit Bank (KKB), although far from the largest banking organization in West Germany, and far from being the most automated, does a reasonable business, and realizes the ultimate necessity of automation in this dynamic sector. The KKB's market share of all West German banks amounts to one-half of one percent of the total number of branches, one-half of one percent of total consumer savings, and 2.6 percent of all consumer loans. KKB, after its founding in 1926 as a small loan company in Prussia, has not grown at an inordinate rate, as the previously mentioned market share data would indicate. However, of the consumer banking sector of the West German banking industry, KKB is a relatively large part—246 of 600 consumer bank branches are KKB's.

KKB, at the end of 1979, employed 2640 workers in its 246 branches—an average of almost 11 employees per branch. It is important to note this figure has remained relatively constant over the last ten years, even with rapidly growing business. Total employment at KKB has generally not increased as fast as the volume of business. This in great part can be attributed to the bank's moves to automate its operations.

Data processing equipment was first installed in 1962. Today there are approximately 700 VDT's spread throughout the bank's offices. The bank's philosophy in their approach to automating their operations has been to use data processing to support the operations of the branch banks as their business expanded. Their overall goal is to eliminate the back office process in banking and bring all employees to the front where they can be most productive in customer contact. In doing so, of course, many of the back office jobs are also eliminated.

Similar approaches are evident at larger banks. The Trade Union Bank (BfG), headquartered in Frankfort, is the fourth largest universal service bank in West Germany with 1979 balance sheet assets of about $25 billion. The BfG is indirectly but totally owned by West German trade unions. It has 250 branches in West Germany, in addition to foreign branches located in New York, London, Brazil, and Hong Kong and employs about 6,000 persons in West Germany alone.

The BfG operates like any other privately owned universal service bank in West Germany. Some 93 percent of its business is carried out with industrial customers. Its goal is to make a profit as large as possible and diversify without taking undue risks. It is not a mutual savings and loan type operation for the benefit of trade union members although, in deference to its size, its policies may influence banking conditions encountered by working people. It tries to improve banking conditions as much as possible but that is not its policy, and indeed it is illegal to discriminate in the favor of trade union members. It is however, able to provide quick, strong, and convenient financing for trade unions in general, particularly in the financing of strikes, and its substantial profits finance social projects desired by the trade unions.

The strength of the BfG derives from the high percentage of trade union membership in the West German workforce. This unity of strong and wealthy trade unions, and favorable West German banking laws, allows the formation of a bank such as the BfG. Trade unions invest their strike funds in the BfG to allow them to capitalize on this pool of money invested in the world economy. In turn, the BfG uses these strike fund monies as collateral in making loans to trade unions during strikes. Solidarity is such among the trade unions that when one is on strike and needs financial support, other trade unions will put their own assets up as collateral for loans made to the union in need. Trade union members are aware that the investment of their own funds with BfG allows their use in strengthening the entire trade union movement in West Germany. The Board of Directors of the BfG consists of the presidents of the 17 trade unions affiliated with the DGB, thus adding more insurance that the policies of the bank will be supportive of organized labor to the full extent allowed by law.

The progress of the BfG in implementing new technology is similar to what is found at the KKB. There is movement toward placing all banking records on a computerized data base using VDTs in branch banks for realizing transactions. Computer experts at the BfG estimate that once this conversion has taken place, there will be no manual work left to be done in transacting the bank's business. The process of computerizing operations began in 1978 and is expected to be finalized in 1981. The inexorable march to the use of automatic teller machines will be completed at that time with deposits, withdrawals, payments, and statements being handled by that equipment. With an estimated 17 million transactions now taking place, the BfG's computer experts estimate that hundreds, perhaps even thousands of additional workers would be necessary without the computerized equipment.

The bank's view is not only that automation will make the organization more efficient, but that it allows the employees to spend more time with customers. Studies done of customer attitudes towards computerization indicate a great deal of hesitancy about people actually using the machines themselves in making transactions. It is speculated that when one's own money is at stake, customers don't wish the responsibility of performing their own transactions. This, of course, will change as the equipment becomes more familiar, which does not bode too well for employees of the BfG or the industry as a whole.

The insurance industry in West Germany is experiencing a leveling out of employment, even though the volume of business is greatly increasing. What this means for the economy as a whole is a very difficult question to answer, considering that the service sector is the last to develop in a thoroughly modern economy. It is legally impossible for a company in the insurance industry to branch out into other businesses thus disallowing the use of its profits for expansion into other sectors of the economy.

The Victoria Insurance Company, organized by the HBV, is the fourth largest insurance company in West Germany, doing $1.5 billion in business annually with some 7,000 employees and 4,000 agents. Their movement to new technologies was spurred by a desire to decrease their personnel cost in relation to their total operating costs.

Even though the company uses a large number of computers to perform a large number of functions, VDT use is said to be limited, with no one person spending more than 50 percent of their work day at a terminal. The company uses about 80 VDTs now, about half of which are in their headquarters operation, and the other half distributed to their field operations. They intend to increase the number of terminals in use, step by step.

Günter Volkmar, president of HBV concedes that there is some risk as computerization spreads throughout the insurance and banking industries, and into other white collar areas, but that trade union opinion in West Germany is that this risk can be controlled—resources can be diverted to reschooling and retraining, and many new opportunities can be opened. In addition, work times could be shortened, longer holidays and study times could be allowed, and resources that remain untapped could be better investigated to provide activity for many persons. More emphasis could be placed on social matters, the disabled, and increasing the development of the German social welfare system by encouraging new lines of thought.

It is most important to be aware of the problems, and to foster open discussion. Unions, companies, and government must be brought together to start planning for solutions to the problems in advance. An important role of the unions in this increased awareness is not just to recognize the potential for problems but to devise their own ideas for solving the problems.

The West German insurance industry has often been a leader in bringing new developments to the labor/management relationship that have opened opportunities for advancing that relationship. For example, the 40 hour work week, six week vacations, and early retirement originated here and have since spread in various forms throughout the rest of the economy. The parties involved are convinced that there is still room for the industry to expand and create new employment opportunities.

United Kingdom

The U.K. is the fifth largest trading nation in the world, exporting many types of machinery, vehicles, aerospace products, metal products, electrical equipment, chemicals, and finished textiles. Given its limited amount of arable land, the U.K. is a major importer of food products. In contrast to other European countries, Britain is now riding high on a wave of oil pumped from North Sea fields. In this respect, at least, its economy is free from the fluctuations in world energy prices to which most other modern industrialized nations are subject, although it has also kept up the value of the British pound, making British goods less competitive. The U.K. has led in the export of services such as banking, insurance, shipping, aviation, and tourism, an indication of an economy in its most advanced stages of development.

Over the last thirty odd years, government power has alternated between the Labor party and the Conservative (Tory) party, with strongly divergent views. At present, the government is in the hands of a Tory government under prime minister Margaret Thatcher. Traditonal differences in party policy in such areas as unemployment, union rights, economic growth, taxation, education, the extent of government ownership of industries, and operation of the economy are at their widest in many years.

Labor law in the U.K. is based on British common law. Labor unions have no specific legal basis for their existance, having developed on an ad hoc basis late in the last century. Laws regarding the exercise of labor union functions were first proposed in the late 1800's with the Trade Union Act of 1871, giving trade unions protection from the criminal and civil consequences of restraint of trade. The Conspiracy and Protection of Property Act of 1875 extended those original basic protections and permitted peaceful picketing. The Trades Disputes Act of 1906 protected participants in trades disputes from civil suits.

Rising labor unrest in the 1960's led to passage of the Industrial Relations Act of 1971 by the Conservative government, a move that was vigorously opposed by the trade unions. The subsequent Labor government repealed the Act, which was modeled on the United States' Taft-Hartley Act, in return for promises of moderation in trade union demands and the establishment of a "social contract" between labor interests and the government. A new legislative framework was developed that imposed very few restraints on trade union activity. Throughout the term of that Labor government, laws were enacted that expanded trade union rights. These were consolidated into the Employment Protection Act of 1978, expanding the rights of individuals in the workplace, and extending the rights of trade union activity in other areas.

The current Conservative government, on entering office in 1979, amended the 1978 act to readjust the balance of power between labor and management. These amendments mandate, among other things, government funds for secret union ballots, limits on picketing, and the removal of immunity for secondary boycotts and picketing.

Even with all the seeming confusion, employee rights have expanded significantly in the past 15 years in British law:

- Written notice of terms and conditions of work, including advance notice of termination
- Severance payments
- Protection against unfair dismissal
- Guaranteed right of union membership
- Paid time off for union activities
- Maternity rights for women
- Protection against discrimination.

Legal rights of trade unions have also expanded to include:

- Right to information on company finances for use in collective bargaining
- Advance consultation in the event of layoffs
- Right to appoint and train union safety representatives
- Ability to prevent discrimination in the workplace.

Social welfare legislation in the U.K. has not reached the advanced stages of Sweden or West Germany. However, they do have a national insurance plan that provides sickness, unemployment, and pension benefits under the Social Security Act of 1975. This plan is financed by employee, employer, and government contributions, and the benefits are indexed to the cost of living to provide protection against erosion by inflation. Maximum retirement age is set by law at 60 years for women, 65 for men, and 60 for senior civil servants. Current "Job Release Schemes" provide a form of early retirement specifically designed to open job opportunities for younger workers. This enables men to retire at 62 and women to retire at 59 with paid benefits. Collective agreements often supplement these provisions of the law. The standard workweek in Britain is 40 hours for wage earners and 37.5 hours for salaried employees. Paid vacations are generally on the order of three to four weeks. Hours and vacations are not embodied in law but are the result of collective bargaining.

In many ways, the situation in the U.K. is quite reminiscent to our own in the United States—labor unions fighting for every concession they get, management that appears as unyielding as that of the United States, and a government that considers its policy of high unemployment a necessity in its fight against inflation. The relationship between the current Conservative government and the trade unions is not good, nothing like the close working relationship developed in some other countries.

Labor

Membership in trade unions in the U.K. is estimated to be nearly 50 percent of the labor force. Almost 20 percent of this amount has been added in the last ten years as white collar workers, seeing themselves subject to the adverse effects of new technologies, organized in large numbers. Today about one-third of U.K. trade union membership is white collar and ranges from white collar workers in manufacturing to managers and supervisors.

The Trades Union Congress (TUC) in many ways resembles the AFL-CIO. The TUC has about 110 affiliated unions representing over 12 million workers. It plays a consultatory role with the British government on labor matters and a broad range of other subjects affecting work and working life in the U.K. The TUC performs a coordinating and informational role for its constituent unions, setting guidelines on union activities and assisting in negotiating and settling disputes among trade unions.

L. to R.: David Lea, Assistant General Secretary, TUC, and Rodney Bower, IFPTE

Most trade unions in the U.K. are organized along craft or occupational lines although a few industrial labor organizations exist, most notably in the nationalized industries—coal, steel, and railroads.

The TUC has its counterpart in industry in the Confederation of British Industry (CBI) whose membership includes about 15,000 companies, 200 trade and employers' organizations, and most nationalized industries. The CBI acts as an informational clearinghouse and spokesman for British industry. It has no bargaining role but advises its members on important bargaining issues and as a group sets industry bargaining policy. As the TUC is consulted by the government on labor related issues, the CBI enjoys the same position on the industry side.

In bargaining, the British negotiate two different types of agreements—a substantive agreement for wages and working conditions that lasts generally one year, and a procedural agreement. The latter is a long-term addendum to the substantive agreement which sets procedures for modification of the substantive agreement over time and resolution of any disputes arising over the contracts. In spite of widespread unionization in the U.K., collective bargaining is a highly fragmented process that takes place on several different levels. Most common is industry-wide bargaining occurring between multi-employer associations and trade unions which will result in formal national agreements. Growing in frequency however, are shop steward agreements negotiated at the shop floor level resulting in local, informal understandings.

On technological change issues, the TUC has both led and reflected the growing concern of British trade unions. Especially in an era of historically high, and rising, unemployment levels, and faced with the real possibility of future economic growth coming about through the introduction of technologies which reduce the need for manpower, unions in the U.K. are actively seeking ways to deal with the problems.

The TUC is studying several approaches. One is the possibility of having data stewards, to use the Norwegian terminology, on the shop floor. These persons, union members, have the responsibility for keeping abreast of technological developments as they occur in different plants and reporting their findings to their union's national offices. The TUC sees data stewards as a valuable option; however, they also admit that no idea for dealing with technological change is applicable in every situation. There may be overall differences in emphasis by various unions, but representatives on the shop floor, whether "data stewards" or not, are a necessity.

Union membership training is a thrust considered of vital importance. Trade union education sponsored by the TUC reaches some 60,000 persons a year who participate in courses of about one week's duration. The TUC in its education program is attempting to match what is being taught with what is actually occurring in the workplace, with the aim that educational provisions for shop floor representatives, safety representatives, and full-time officers, takes full account of the implications of new technology. This implies, of course, that the TUC has enough knowledge of new technologies to be able to develop the appropriate training courses for its representatives. This is a subject that is of constant concern—how does the federation or an individual union gain the appropriate expertise?

The educational philosophies of the various TUC trade unions differ widely. Some concentrate more on trade union issues than technological change, some exactly the opposite. Expertise in issues relating to technology is gained in many different ways also. Many unions will bring in outside experts to develop the membership training in technological issues; however, there is a growing group who believe the expertise already exists within the membership. After all, it is with the membership that new technology originates (in the ranks of scientific and technical members), and it is they who present the front line against new technology when it is introduced, so what better source to turn to than the membership itself. This thinking is still in the formative stage, and few unions have yet developed any significant in-house technical expertise, but their knowledge is growing simply from the intensive research that continually takes place on the subject.

The trade unions of the TUC recognize one major hindrance in their search for technological expertise—not being able to pry information out of multinational corporations. International technology transfer is no doubt occurring through the multinationals and it is of primary importance that contacts with multinationals be improved through the efforts of international trade secretariats.

Clive Jenkins, General Secretary, ASTMS

The TUC, in all its searching for the right answers, has taken a large lead in work toward understanding the effects of technology on the workplace. As outlined in a report by the TUC General Council to the 1979 Congress, they recommended giving priority to movement towards:

- The 35 hour week
- A reduction in systematic overtime
- Longer holidays
- Better provision for time off for public and trade union duties
- Sabbatical leave
- Early retirement for older workers on improved pensions
- Increased knowledge.

Technological change and its effects has become a major issue among large segments of the British trade union movement. This includes such groups as the Council of Civil Service Unions and the Council of Post Office Unions, as well as individual unions such as the Association of Scientific, Technical and Managerial Staffs (ASTMS); the Association of Professional, Executive, Clerical and Computer Staff (APEX); the Post Office Engineering Union; the Banking, Insurance and Finance Union; the National and Local Government Officers Association, to name but a few. As in the United States, the search for solutions is made more difficult than might be the case otherwise by the large number of unions in the U.K. and the consequent fragmentation of the workforce and potential for continuing jurisdictional disputes. Nevertheless, there appears to be a widespread recognition of the potential problems, and an agreement that some issues are universal—protection and preservation of jobs; sharing of productivity benefits with the employees; and the need for management to consult early with the unions when technological changes are contemplated.

Government

Britain is a parliamentary democracy, and as such, the Prime Minister is always of the same party as the majority of members of the House of Commons. Also, party discipline is much more rigorously adhered to in the U.K. than in the United States. The result is that the party in power has almost complete freedom to implement its policies.

There are vast differences in philosophy and approach between the Labor Party and the Conservative Party, the two dominant political parties in modern day Britain. Hence, government policy takes large swings when the incumbent changes. The Labor Party was formed in 1900 by the trade unions themselves. Over the years it has garnered much of its leadership and financial support from the unions, although a significant minority of union members vote Conservative. The Conservatives receive substantial support from private business, and have been in power since May of 1979.

While the Conservatives won on an openly anti-union platform, they cannot totally ignore the labor movement. They consult regularly with the TUC, but their current economic policies, with high unemployment as a major part of their plan to halt inflation, assures that their relationship is not a close one.

The government is quite interested in technological change as a means for improving the very low productivity growth of the British economy. Not

DPE study group meeting at the National Microprocessor and Electronics Centre, London. L. to R.: Michael Dymmel, CWA; Clarence Robinson, BRAC; Gwen Wells, OPEIU; Harry Floyd, IATSE; Reggie Newell, IAM; Richard Perry, UFCW; Steve Early, American Labor Education Center; Robert Nielsen, AFT; Dennis Chamot, DPE; Rodney Bower, IFPTE.

surprisingly, their current estimates of employment impact are far rosier than those of the unions.

The Department of Employment is most similar to the U.S. Department of Labor. It is responsible for a major study of the impacts of microelectronics in the U.K., "The Manpower Implications of Microelectronics Technology," published at the end of 1979. Six conclusions resulted from this study:

1. Unemployment in the U.K. would be higher without the use of microelectronics than with it;
2. The alarmist views on the impacts of microelectronics are not supported by the study's findings;
3. In manufacturing industries, process changes will cause job losses, product changes may either increase or decrease employment;
4. Some of the skills that are needed now are in short supply – the educational system cannot be expected to lead the revolution;
5. The potential effects of the new technologies will not impact the service sector for some time but the changes required in the nature of the service sector labor force will have to start occurring; and
6. Union attitudes are extremely important in a smooth transition to the new technologies.

Many structural problems are also indicated by the above analysis. Microelectronics has the effect of exacerbating problems related to the structure of an industry. One problem recognized in the methodology of the study itself was the time frame involved – only five years. The authors believe five years to be a significant period of time for which planning can realistically occur, but many of the impacts of drastic changes in technology may occur further down the road.

The British are relying on their ability to compete in world markets to carry them through any impending crisis. It is clear that government involvement will be necessary to assist people in adjusting to the increasing rate of change. The government now requires that any firm with more than 10 employees which expects redundancies (lay-offs) must notify the unions involved at least 30 days before the redundancies are expected to occur. Companies with 100 or more employees must give notice 90 days in advance. This helps a little in advanced planning for redundancies. However, all employers pay into a government redundancy fund that repays them part of the amount that they must pay employees in severance pay. An employer may withdraw up to 41 percent of his contribution to this fund, leaving his total cost of paying for redundancies only 59 percent. Simple cost-benefit analysis on these figures makes it clear that British government legislation, ostensibly in the favor of workers, can operate in exactly the other direction. It can operate as a tax incentive to modernize through the use of labor saving technologies, especially when the most advanced technologies with the greatest labor reducing capabilities are dropping the cost rapidly. This apparent conflict is recognized but the concept of this fund is still considered to be an underpinning of a systematic attempt to help people adjust to technological change.

The second underpinning to this system is training. The U.K. has a well established network of 24 industrial training boards that set standards for training and check the quality of training that is done. Both labor and industry

L. to R.: Dennis Chamot, DPE; Neil M. Vann, NVA Consultants, Ltd.; Rodney Bower, IFPTE, and Michael Dymmel, CWA

have equal representation on these boards and professional educators act in consultation. The boards oversee the progress of the state financed Training Opportunities Programs that provide retraining or initial training for the unemployed or underemployed. Training programs, offered in a wide range of skills, average six months but may be extended in cases involving retraining for technological changes. Potential trainees are recruited when they apply for social unemployment benefits, but attempts are being made to match persons declared redundant and awaiting their layoff with opportunities for retraining. Those persons in training are supplied with a stipend by the government that does not approach an actual wage but is significantly above the unemployment benefits available, acting as an incentive to participate in these programs. Placement rates on completion of training average 60 to 70 percent. It has also been found that those persons who are recently unemployed and are involved in retraining have a much better chance of successful placement than those who have been unemployed longer than three months.

This program of training has been subject to recent cutbacks in funding as have most social welfare programs under the Conservative government. A previous concentration on retraining in clerical and commercial areas has been reduced but programs in the areas of new technology have not. In general, the training objectives of labor and management are not widely different in the U.K. Programs tend to be of a broad nature, not directed at specific workers and specific jobs, but at workers skilled in broad areas such as computer programming.

The British Department of Industry, like the U.S. Department of Commerce, is more concerned with increasing productivity of British industry, and stimulating technological change. Productivity was at an all-time low rate and industrial production was declining when it was decided that microelectronics would be the most important technology for at least the rest of the eighties. It also was becoming apparent that micoelectronics might spell the success or failure of the economic growth in the U.K., prompting major government initiatives in promoting the development of microelectronic technology in British industry. A Microelectronics Applications Division was created within the Department of Industry to foster the development and use of microelectronics throughout all levels of industry in the country, a program that has met with a good deal of success in its first few years.

The thrust of MAP (Microelectronics Application Program) has been in four directions: financial support, training, consultancy, and development of new programs. MAP started with initial funding of about $38 million early in 1978. Later that year, an additional $138 million was added to assist the program in reaching its goals of alerting managers and shop floor workers to the potentials of microelectronics. To date an estimated quarter million people have been reached through monetary and material support of existing programs.

In the area of training, short courses were developed using an open university concept consisting of correspondence courses and television-based instruction. About $1.25 million has been given to the TUC to fund the development of their own programs aimed at educating workers.

Acting as a consultancy, the MAP gives two to three man-weeks of initial assistance to firms desiring to further develop their own microelectronics applications program. Consultancy accompanies the fourth thrust of this program, that of assisting firms in starting up new microelectronics development programs. Slightly less than half of the total funds alloted in this program have to date been expended in the development of new programs. The MAP still estimates that at least one-half of the British industrial sector still has no practical knowledge of microelectronics and their applications.

Industry

Labor-management antagonism in the U.K. appears to be far greater than in any of the other countries discussed in this report. Unions are not represented on company boards; strikes are relatively frequent; and companies easily resort to layoffs to attack short term economic problems.

An example of the distance yet to be traveled is shown by the recent attempt to conclude a technology agreement between the TUC and the Confederation of British Industry (CBI). While the CBI, the industry umbrella group, accepted the agreement, its member firms rejected it, demonstrating a lack of desire on the part of British employers to share with the representatives of their own employees any real degree of planning and decision making.

At the local level, some industrial actions have taken place over the introduction of technological changes. For example, Bush Boake Allen (BBA) is a division of Albright and Wilson Laboratories, a Britian-based firm which is itself a subsidiary of the U.S. multi-national, Tenneco. BBA's operations are international in scope with divisions in 14 countries around the world, including the United States. BBA is primarily involved in chemicals with a plant near London which produces spices, perfumes, and aromatic chemical ingredients for food stuffs.

The operations at BBA are highly reliant on computer technology for efficiency, using them in its production operations primarily as tools for complex chemical analyses. BBA also has introduced computerization to its office operations in the forms of data processing and video display terminal equipment. However, the introduction of this equipment was a unilateral decision on the part of management, and the union, the ASTMS, believing that it should have been consulted on the implementation, has "blacked" the equipment and refused to use it until management would negotiate over job division and working conditions as they result from the new equipment. Union billboards in the plant carried notices that, for the sake of solidarity, no union member should concede to management's desire to put the new equipment into operation until management was willing to bargain on the central issues surrounding the use of this technology.

A document by the ASTMS put forth the following policy concerning technology change at BBA:

"It is essential that the Company enters into a *TECHNOLOGY AGREEMENT* to ensure the orderly, smooth and effective transition that is in the interest of both Management and Workers. Moreover some agreement on no enforced redundancy as a result of microelectronics would appear necessary.

"This is not in itself enough. To man a technology agreement each group of workers or Department will need to have a *TECHNOLOGY REPRESENTATIVE* to look at the nature of these developments.

"We must have a *Technology Agreement.*

" '*Technology Representatives*' must be elected and trained.

"All staff must be trained now for the changes. Special facilities must be made available for Managers and Representatives to be fully aware of the problem.

"Failure to implement the new technology in an effective way mean none of us have jobs; even at best people may have jobs less interesting than were possible.

"If we want safe rewarding work we must take an active part in the implementation and preliminary planning of the new work systems that will be required to take advantage of the new technology."

Whether the union will be successful in its endeavors in this area is unknown at the time this is being written, but the new equipment in the meantime has been sitting idle.

Some parts of British industry have also moved into the forefront of development of high technology products.

Demonstration of Teletext and Prestel Television Information Systems to DPE study group by Mullards personnel

For example, Mullard House is a division of the Phillips Group Ltd., international manufacturers of industrial and consumer electronic equipment. The Mullard division was itself involved in the development and production of Britain's entries into the Teletext and Videotext fields.

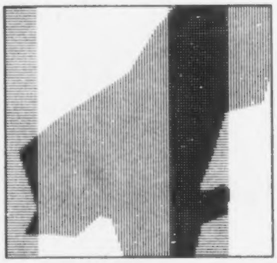
Britain has gone commercial with its use of these communications technologies. All television receiving equipment manufactured in the U.K. now contains electronic convertor circuitry for tying into one or the other system. Teletext is a one-way, non-interactive system which allows the reception of news and other informational services on home television sets. This information is broadcast along with the standard television signal in unused portions of the broadcast band. The built-in convertor allows the user to select the information he desires from a maximum capacity of approximately 200 pages stored in the broadcast signal. This maximum capacity could be enlarged considerably.

Videotext is a two-way interactive communications medium that uses the telephone network for connection between a central informational source (the British Postal Authority's central computer in this case) and the home viewer. The convertor that is built into the receiver is switchable between this communications medium and regularly broadcast television reception. Videotext offers information similar to that of Teletext, but in addition it allows the viewer to communicate with the informational source for such purposes as shopping and making hotel and airplane reservations. By the end of 1981, Mullard estimates that over one million sets with Videotext capability will have been sold. Both these systems enable the viewer, through the use of auxiliary attachments, to print data being viewed, and tape such information for later use.

The employment effects of either system are difficult to estimate considering their newness. Teletext, if it is significantly expanded, may impact employment in the conventional print media; however the abbreviated nature of the news information being carried over Teletext is unlikely to cause any displacement in its present incarnation. Videotext is capable of the same employment effects, with a few additions. In its interactive mode, Videotext enables a consumer to shop, buy, and pay for items such as groceries or department store merchandise using his home television. Widescale development of the potentials of Videotext could cause displacement of customer contact personnel in many areas of the commercial industries that tie into videotext.

Now being experimented with is the use of Videotext for business purposes. Mullard executives are able to use their home TV receivers to connect to their work locations and perform all of their work from the comfort of their living room easy chairs. Mullard has tied its videotext connections into its own mainframe IBM computer, and any employee using the right code can tie into the computer, examine and update information stored there, transmit correspondence, etc. To enable these potentials to be more flexible, there is also work being done in the development of portable terminal equipment so that a person's office can travel with him wherever he goes.

Norway



No discussion of European approaches towards technological change would be complete without mention of the interesting situation in Norway. Believing that change is inevitable, and hence it should occur only with the consent of workers and their unions, the Norwegians are developing a system through which control of technology is a joint labor-management right.

The current technology agreement can be characterized as a rejection of labor-management cooperation on the issue, and the beginning of a struggle on the union's part for more information and greater control. Management is looked upon as an ideological equal in the struggle, but much better funded.

This all began with a pilot project of the Norwegian Iron and Metal Workers' Union in the early 1970s. The project brought local union members together with sympathetic computer technicians from the Norwegian Computing Center, a state supported institution. Their joint studies of technology in the workplace led to the formulation of worker alternatives to managements' plans for introducing new technologies. Both groups learned a lot—union members gained an understanding of computer technology, essentially "demystifying" the subject, and computer professionals learned what trade unionism was all about.

The unequivocal success of this project resulted in the first Data Agreement of 1975 between the Norwegian Federation of Trade Unions (LO) and the Norwegian Employers' Federation (NAF) which, two years later, was enacted into law. This agreement allowed worker participation in decisions which affect their jobs (codetermination), provided for advance notice of technological changes, and established the concept of "data steward"—shop floor representatives whose responsibility it is to be informed of changes occuring in the workplace so that they may use their knowledge to allow union members to understand and react intelligently to proposed technological changes.

The original Data Agreement of 1975 between LO and NAF was revised in 1978 to cover computer-based systems used to plan and carry-out operations as well as compile personal data. The agreement itself begins on a very positive note that the LO believes is a requirement for influence: "Computer-based systems can be useful tools in the planned allocation of the total resources of an enterprise . . ."

A broad approach is indicated however: ". . . it is important that computer-based systems are evaluated (from all angles), so that all the aspects are taken into account in the development, introduction and use of such systems."

Information on technology is a central issue: "Management will . . . keep their employees informed about all matters which are covered by this agreement . . . The information will be given clearly and in a language easily understandable to those without specialist knowledge in the area concerned. . . . management and the shop stewards . . . will give the employees sufficient information for them to understand the fundamental features of the systems which they themselves either use or which affect them. They must . . . be given sufficient information for them to understand the importance of such systems, not only to the enterprise but also to the employees and their working conditions . . . employees who will be directly affected by the new systems . . . should, to the greatest practical extent, be involved in the preliminary project work . . . lost earnings and any expenses incurred in obtaining information will be covered."

Special representatives—data stewards—are provided for: "If the employees . . . so desire, they may elect . . . a special representative to safeguard their interests . . . The representative will have access to all information . . . Shop stewards and employees participating in actual projects will have access to all necessary documents on the project area.

"The enterprise will make sure that the special representative . . . is given the necessary training in general data processing techniques . . . systems analysis, programming and project administration . . . to develop the competence needed for participating actively in system design."

Information subject to data processing is restricted and protected: ". . . collection, storage, processing and use of personal data will not take place unless it can be objectively justified as being necessary for the work of the enterprise. . . . management, in cooperation with the shop stewards, should draw up a detailed procedure in the storage and use of personal data . . ."

Finally, the agreement is not limited: ". . . further agreement may be concluded for a particular individual enterprise . . . If . . . agreement is not reached, each party may submit the case to the central national organizations."

It is important to note that information and its acquisition is central to the success of this agreement. Information is to be transmitted through the shop stewards, a well-established concept in Norway that has its basis in long-existing central agreements. It should also be noted that no Norwegian labor-management agreements are legally enforceable, unless specific provisions have been enacted into law—the parties are bound only by honor.

One last vital consideration—because of technology bargaining and data stewards, technological change in Norway is seldom thought to be inevitable as it is almost everywhere else. It, and its attendant fears, have been reduced to one more factor affecting worklife that is subject to social action and control.

Discussion

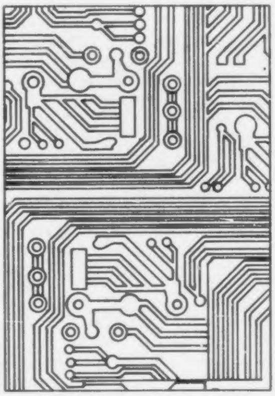
American and foreign trade unionists have much to learn from one another. Nowhere is this clearer than in the area of technological change and the problems deriving therefrom.

Technology develops rapidly in our modern world, both from the original conception to practical application, as well as from country to country. It is not at all unusual to see a technical advance be conceived and developed in the United States, be applied to products by Japanese manufacturers, and then appear in goods sold around the world. We have become a very interdependent world, with international trade becoming ever more important.

The technical advances are amazingly broad. They range from industrial robots to word processors and computerized filing systems; from computer control of factory production and parts inventories to automatic bank teller machines; from "smart machines" with built in microchip computers to complex electronic communications systems coupled to massive capacity data processing systems.

Every Western industrial country is participating in this technical revolution. The effects upon employment levels, job content, worker control of the job, and other subjects of direct importance to labor are beginning to be felt everywhere, for the new advances are not only changing commercial products but are also transforming industrial manufacturing processes and office work.

Many of the European countries, as well as Japan, are much more heavily dependent upon exports than the United States, and also import relatively much more. They are acutely aware of the need for remaining competitive in a rapidly changing world, a situation which is fairly new for the United States, but which is becoming quite important.



This recognition of the need to stay competitive, usually stated as the need to improve productivity, is common to every country studied in this report, and to one extent or another, it forms the basis of much of the discussion between government, labor and management. How do the Europeans view current and future developments? What problems do they foresee as a result of technological changes? And how are they trying to deal with them?

In Sweden, there is the expectation that one-third of the jobs in banking and thousands in insurance will be eliminated over the next decade; that conflicts will intensify between typesetters and editorial staff using computerized equipment; that industrial robots will spread widely throughout industry; that computerization will lead to less worker control. The West Germans are also concerned about robots and computerization of manufacturing processes, having already seen the rate of job growth slow down in some industries where such equipment is being used; and they are wary of the computers' effects on the number of jobs that will be available in the banking and insurance industries. Both of these countries have been relatively prosperous recently, so their problems are still manageable.

The United Kingdom, on the other hand, has for some time been experiencing high inflation and extremely high unemployment rates. Even so, their unions expect problems similar to those described above, but worse. With the British economy doing so poorly, there is a lot of pressure for modernization and improvement of productivity through job reorganization (read that, "using fewer people"). The British unions in particular are quite disturbed about the implication of microchip technology in the British context – replacement of workers by machines, even in the face of high unemployment.

How are our European colleagues trying to deal with these problems? Right at the start, it is important to note that each country has developed a unique set of laws and customs. Whatever they do must be seen within the context of this background, because some of what they do is not easily transferrable to the United States.

Sweden, for example, is a small country (population about 8,000,000) which must export to survive. It also has a fairly homogeneous population with a long history of social concern. Better than three-fourths of the total Swedish workforce are union members. One of the major political parties, the Social Democrats, has close ties to the blue collar labor federation, LO, and until 1975 had been in power for four and one-half decades.

There is widespread and continuing recognition throughout Swedish society of the value of labor unions in representing the interests of employees. Representatives of the labor federations are included on government panels and commissions, and even though the Social Democrats are no longer in control of the government, low unemployment is still a major planning goal.

Some of labor's concerns have been incorporated into law. For example, Swedish workers are legally entitled to five weeks of vacation every year, helping to spread the work around. Should they lose their jobs for economic reasons, including job loss resulting from the introduction of new technology, they may participate in comprehensive government sponsored education and retraining programs. These programs may last up to two years, during which time the participant receives a wage which is purposely set a bit higher than unemployment compensation, to encourage enrollment in the programs. At the end of the course, workers still unable to get jobs may sign up for another course.

The Swedish context is determined by more than just the legal framework, as attractive as much of that is to Americans suffering through a succession of conservative administrations. Of equal importance is the widespread attitude among Swedish employers and unions alike that routine layoffs are not to be permitted as a normal part of business planning. With a fair amount of job security, workers throughout the economy can more readily accept changes that will boost productivity, even while demanding a major role in the decision-making process.

Yet, even in Sweden, the situation is far from perfect. Management is still interested in the bottom line, and this can lead to strong disagreements with the unions. Also, local union leaders may not be as well informed and knowledgeable about sophisticated technical developments as management representatives are, and thus may be unable to fully anticipate negative implications of planned changes. Ultimately, management has the final authority to make whatever decisions they want, subject only to legal and collective bargaining constraints. While there is in general a far greater willingness to cooperate with unions among Swedish managers than their American counterparts, they still have a great deal of power to determine the direction and rate of future developments. This is particularly true for technological advances, which by definition represent changes, often very complex changes, from what had been done before.

The Swedish unions, as with many others, desire more advance notice of impending changes. While they have been experimenting with codetermination systems, where union representatives sit on the board of directors of companies, this has not yet gotten very far.

The Germans have gone further than anyone else with codetermination. In the Coal and Steel industries and in companies with more than 2,000 employees, half of the members of the Board of Supervisors (in many ways equivalent to Boards of Directors in American companies) by law must represent employees, the other half representing stockholders. In companies with fewer than 2,000 employees, employee representatives make up one-third of the Board. In addition, all companies with greater than five employees are required to establish Works Councils, which are elected by the employees. These councils are not union locals and do not negotiate collective agreements, but management must work with them on local issues and grievances. This clearly includes issues related to technological change—introduction of new machinery or equipment, staffing needs, retraining, hours of work, reassignments, dismissals, and so on.

The combination of seats on the Board, local Works Councils, and national or regional negotiations between national unions and employer federations offers the German unions unprecedented opportunities for obtaining advance notice of coming changes. Even so, the *details* of those changes may be withheld for some time, and in any case, management still has the right to make the final decision.

Even if the information were complete, that is not enough. The German unions, based on their own studies and those of their government, expect to see job losses in some areas as well as reductions of skill levels brought about by technological advances, unless steps are taken now to modify the situation. While the German economy is the strongest in Europe, and low unemployment levels are still the national policy, sticking to that policy may be more difficult in the future, the unions fear, unless the government gets much more involved in job creation activities. Agreement on this point is far from the high level achieved in Sweden.

The British situation is worse, and in many ways, resembles our own. Unemployment is very high, inflation rates have been worse than ours, and the government now in power ran originally on an anti-union platform. In the face of massive economic problems, there is a strong desire in Britain to push for modernization of industry. To a great extent, this attempt focuses on introduction of computer and microchip technologies specifically to reduce labor costs.

Labor-management cooperation in Britain is at a level far below that in Sweden or West Germany. Government and management seem intent on breaking the "power" of the unions, even at the risk of great economic hardship for large numbers of people. The British unions believe there is a very real danger of economic growth occurring through the application of microchip and computer technology at the same time that unemployment grows.

What can be done? Even in Britain, the unions have adopted the realistic view that, in general, one must accept the inevitability of change. The emphasis is on seeing to it that their members are protected as much as possible from negative effects, and that any benefits derived from technological change be fairly shared. This is nothing more than a defensive strategy, and in looking ahead, several unions and the Trades Union Congress, the national labor federation, have been developing model technology agreements to pursue through collective bargaining. The following are some of the ideas suggested for including in such contracts:

- No unilateral changes
- Full consultation with the union before any decision is made to purchase new equipment
- Advance information for, and regular consultation with, the union to plan adequately for future developments
- Job guarantees for present employees, including retraining and internal job shifts where necessary.
- Safeguards against excessive managerial control, or employer misuse of computer generated data
- Safeguards against new safety or health hazards.

While similar technology agreements are being discussed in several countries in addition to the United Kingdom, they are difficult to get established anywhere. Apparently, management representatives don't want to accept any restraints on their planning flexibility, even though these agreements would certainly go a long way toward assuring labor cooperation.

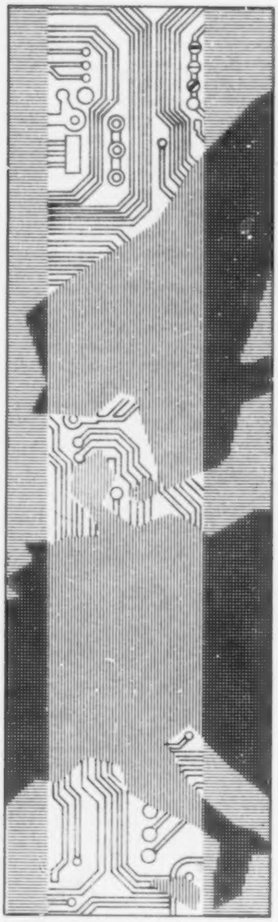
Another problem shared by all, including the American labor movement, is the need for improving the knowledge of our members and staff. The Swedes in particular have shown that widespread, well thought out education programs, backed by government funds, can go a long way in improving awareness and understanding of these issues among trade union members. In addition, we need to constantly update our knowledge of new developments. This is particularly important for local union representatives who are close to the scene when new equipment is introduced.

Everywhere one looks, be it in the United States or Europe, private and public employers alike express interest in new technological developments as a means for increasing productivity, *and halting personnel growth* in that organization. The enormous capacity of computerized systems makes this possible, but the whole is the sum of its parts. If every individual organization seeks to end employment growth, and in many cases to actually reduce total staffing, where will future job creation occur?

This is the great unanswered question. To a great extent, it revolves very much around the question of the rate of introduction of change. If change comes slowly, adjustments will be worked out. If change is too rapid – and the potential for such rapid change is there in the high technology systems already developed – then very real problems will follow *unless* steps are taken equally rapidly to modify the direction or pace of change. And no matter what happens to the society at large, local problems are sure to continue, and must be dealt with.

Our Swedish friends accept the need for constant modernization of their industries, and feel that the government must play a major role in creating additional jobs in service areas which will improve the quality of life. The German unions are looking toward some additional sharing of work through reduced work hours and total working time, and also look to the government for a much more active part in stimulating job growth. Our British colleagues are faced with a difficult political situation, and must rely more on their own devices for the time being.

No one has found the full answer. One thing, though, is clear. We must insist on early participation in planning processes, whether conducted by companies, government agencies, or national public policy makers. We must be involved *before* the damage is done. And we must be prepared.



Appendix

The material contained in this report is based in part on a study tour, led by Rodney Bower, to Sweden, the Federal Republic of Germany, and the United Kingdom, October 6-23, 1980. Participants included:

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Dennis Chamot, *Assistant Director,* Department for Professional Employees, AFL-CIO

Michael D. Dymmel, *Assistant Director,* Office of Employment Programs, Communications Workers of America

Harry Floyd, *International Representative,* International Alliance of Theatrical Stage Employes

Reggie Newell, *Research Director,* International Association of Machinists and Aerospace Workers

Robert Nielsen, *Assistant to the President for Higher Education,* American Federation of Teachers

Richard Perry, *International Vice President,* and *Director of Professional and Health Care Division,* United Food and Commercial Workers International Union

Clarence E. Robinson, *Executive Director,* Industrial Relations Division, Brotherhood of Railway and Airline Clerks

Gwen Wells, *Director of Research,* Office and Professional Employees International Union

Steve Early, from the American Labor Education Center, traveled with the group under a separate grant from the German Marshall Fund of the United States.

We wish to heartily thank our many European friends with whom we met during the trip, not only for their willingness to share information with us, but also for their kind hospitality. There are far too many to list individually, but we would like to offer special recognition to a few people who were of immense help to us in organizing the many details involved with planning a visit of this kind.

In Sweden:

Lennart Bodström, *President,* TCO

Nils Ellebring, International Department, TCO

Carl H. Hernlund, *Secretary General,* Swedish Union of Journalists, and PTK Board Member

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Irena Schnabel, International Department, HBV

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In the United Kingdom:

David Lea, *Assistant General Secretary,* TUC

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Tim Webb, *National Officer,* ASTMS

We would also like to offer thanks to the Communications Workers of America for allowing Michael D. Dymmel to spend a good deal of time assisting in the preparation of this report.

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American Federation of Government Employees

American Federation of Musicians

American Federation of State, County and Municipal Employees

American Federation of Teachers

American Federation of Television and Radio Artists

American Guild of Musical Artists

Association of Theatrical Press Agents and Managers

Brotherhood of Railway and Airline Clerks

Communications Workers of America

Federation of Professional Athletes

Insurance Workers International Union

International Alliance of Theatrical Stage Employes and Moving Picture Machine Operators

International Association of Machinists

International Brotherhood of Electrical Workers

International Chemical Workers Union

International Federation of Professional and Technical Engineers

International Union of Electrical Workers

International Union of Operating Engineers

National Association of Broadcast Employees and Technicians

Office and Professional Employees International Union

Retail, Wholesale and Department Store Union

Screen Actors Guild

Seafarers International Union

Service Employees International Union

United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry

United Food and Commercial Workers International Union

Dr. **Chamot**. I would be happy to try to answer any questions.

[The prepared statement of Dr. Chamot follows:]

TESTIMONY

OF

DENNIS CHAMOT

ASSISTANT DIRECTOR

DEPARTMENT FOR PROFESSIONAL EMPLOYEES, AFL-CIO

My name is Dennis Chamot. I am Assistant Director of the Department for Professional Employees (DPE) of the AFL-CIO. The Department is made up of 26 national and international AFL-CIO unions (list attached) which represent approximately three million individuals employed in virtually every major professional field. Among them are teachers and college professors; scientists and engineers; librarians, social workers, performing artists and associated technical crafts, nurses, pharmacists, laboratory technologists and other health care personnel.

Labor's concerns about new workplace technologies are long-standing. We have learned to deal with many forms of automation in the past, and overall, we, and the nation as a whole, have prospered. However, we believe that the current situation is sufficiently different from the past to warrant close scrutiny, and a high level of concern.

It might help to put things in an historical perspective. As with many countries, the United States began as a primarily agricultural nation. As recently as a century ago, fully one-half of our workforce was engaged in agriculture. As farming productivity increased, primarily as a result of technological advances, many farmers, and large numbers of immigrants, were forced to look for jobs in the cities and the growing factories. Indeed, farming has become so productive that less than three percent of our workforce today are agricultural workers. There are only one-third the number of farm workers today as compared to a century ago, even though our population has expanded several fold.

Manufacturing technology has also improved tremendously. We hear a lot about slow productivity growth rates compared to some of our international competitors; but even so, today's factories are enormously more productive than those of the past. They need to employ far fewer people than would have been necessary if we never advanced beyond nineteenth century technology.

Just as rising farm productivity in the past sent many people to work in the manufacturing sector, so too has developing manufacturing technology in more recent times diminished job opportunities in our factories. For the last few decades, much of the employment growth has been in the service sector, including government. Today, more than half of the American workforce are white collar employees. Even in manufacturing companies, almost a third of their employees are white collar.

Overall, we have seen a shift from agricultural work to manufacturing to service jobs. But today, in the midst of the worst recession since the Great

Depression, companies and governments at all levels are under financial pressure. Everyone wants to improve productivity, and many are approaching the problem with the traditional view that higher productivity is achieved through the use of more machines and fewer people. But we have run out of sectors. Where are the displaced people, and new workforce entrants, going to go?

One can argue that today's technological advances will result in lower costs, business expansion, and ultimately, job growth. This appears to be the pattern in the past, at least on average. But we believe that the past is not a reliable guide to us today, because of fundamental differences in the technologies themselves.

In the past, technological changes were introduced into workplaces in a slow, piecemeal fashion. To a great extent, the changes were quantitative, making a particular kind of machine more productive, or permitting an individual operator to run more than one machine simultaneously. The job itself, though, usually was not drastically changed in its essential features.

Computers and microchips offer the possibility for massive, qualitative changes. It is now possible to seriously think of factories without people. The enormous capacity and speed of computers and microchips allow machines to be given flexibility and some decision-making capability, characteristics formerly within the exclusive province of human beings. Indeed, the often unspoken goal of CIM, or computer integrated manufacturing, is to have computers control all aspects of manufacturing. We can leave the people out, by design.

Now, this somewhat apocalyptic scene will not occur any time soon. Human workers will be required in factories for a long time to come. However,I think it is safe to say that the trend is in the direction of increasing automation, and that as real economic growth resumes sometime in the future, the increased output will be produced with far less rehiring than was the case in the past.

What makes potential problems even worse is the fact that it is not only manufacturing facilities which are increasing their use of computers and programmable equipment. Precisely the same trend is occurring in services and office work in general.

It is interesting to note that developments in office automation are in many ways following the manufacturing pattern. At first, improvements are made in individual machines or jobs. For example, stand-alone word processors replace typewriters, and individual productivity rises. Or computerized microfiche systems replace steel filing cabinets. In essence, the capacity is increased, but the job is recognizable.

But just as there is discussion of peopleless factories, so too is there work toward the paperless office. While it is not explicit, the latter term implies fewer people, too. Again, the key is the extensive use of computers, microchips and sophisticated electronic communications.

Several firms are already offering systems which allow an individual to create documents (from small memos to major reports), including tables and charts; to file or retrieve documents; to tap into large data banks; to send messages to other people hooked into the system; to receive computer generated reports; to do a hundred and one things by himself or herself, without the asssistance of secretaries or file clerks or even middle level managers.

In general, the service sector of our economy has been relatively labor intensive. Automation is occurring here, also. Banks have automatic machines for check processing; computer terminals for their tellers (eliminating a lot of internal clerical work); and automatic teller machines. I have heard that the fast food industry in Japan is considering the use of robots, and it wouldn't surprise me to see that kind of technology adopted here. The telephone system is converting to electronic switching, eliminating both telephone operators and maintenance jobs. Even the U.S. Department of Labor uses an automatic cart for internal delivery of mail.

It can be argued that all of this new technology creates a lot of jobs in the manufacture, installation, maintenance and use of the new equipment. This is true, but the displacement is much greater.

It is a question of relative rates. If productivity increases faster than the growth in output, employment will drop.

I understand that auto industry calculations indicate a net displacement of two to four jobs for each robot installed. In the banking industry, I have heard estimates as high as 30% for the net job loss during the decade of the 1980's, even with great economic growth for that industry.

I could go on with other examples, but the key points are:

1) modern technologies have incredibly large capacities, and;

2) applications are being found throughout our economy, every kind of organization, at every level.

We are faced with nothing less than the redefinition of work. And in the process, a lot of positions will be eliminated.

All of this leaves us with several very major issues. In the first place, we may be entering a period of permanent labor surplus. As the economy improves, the unemployment rate may not drop to levels as low as they have in the past; fewer people will be needed to produce the higher levels of output.

Second, no matter what happens to overall unemployment rates, it is clear that there will be a great need for training, for retraining, and for adult education. Who will provide this? Who will pay for it?

Third, technological developments sometimes tend to take on a life of their own, yet engineering designs are not handed down from Heaven. They reflect the parameters and constraints within which the designers work. The results may not always be those that are most desirable from a social policy standpoint. How can exogenous factors be made a part of the system? Related to this is the whole issue of the devastating effects of plant closings on both the affected workforce and the communities in which the closings occur. We need to find ways to encourage businesses to update existing plants as much as possible, or to use them in new ways, before considering creation from scratch of modern plants in other locations.

Fifth, related to all of the above, where will future jobs come from? We not only need new industries to replace factories that have been closed, but also additional jobs for people no longer needed by ongoing enterprises which have automated, as well as to meet job demand created by population growth.

Perhaps we need to think about spreading the available work around. We have had the eight-hour day, five day work week for decades. We still traditionally have two-week vacations, although many union contracts call for more. Instead of raising the social security retirement age, shouldn't we be looking for ways to lower it? Perhaps some of the productivity gains generated by new technologies should be used to reduce work time without financial penalities for the individuals involved.

Many unions have been trying to deal with problems resulting from the introduction of workplace technologies for some time, including such non-traditional areas as job stress caused by computer pacing. There is certainly a continuing role for collective bargaining in this area. But many of the issues that have been discussed today, and will be discussed throughout these hearings, demand active participation by government, as well.

There is a great need for training and retraining programs, for protections of salaries and benefits as people are shifted into new positions, for real improvements in the quality of working life rather than having the machines dominate the work environment. To a very great extent, we need joint action on the part of all affected parties -- government, labor, business and the community.

American unions accept the need for improving productivity. We are not opposed to new workplace technologies, provided the new equipment is used for the betterment of all and not just for the gains of a few.

Our society could not long exist with ever widening gaps between those who benefit from new technology and those who are cast aside. Proponents of computers and robots like to paint a rosy picture of the better life possible through the application of these remarkable technical achievements. It will not come automatically.

The potential benefits are very great. So are the problems. I commend you, Mr. Chairman, and the other members of these committees, for your efforts in attempting to review these issues in all their broad complexity.

I would be happy to try to answer any questions.

AFFILIATES OF THE DEPARTMENT FOR PROFESSIONAL EMPLOYEES, AFL-CIO

Actors Equity Association

American Federation of Government Employees

American Federation of Musicians

American Federation of State, County and Municipal Employees

American Federation of Teachers

American Federation of Television and Radio Artists

American Guild of Musical Artists

Association of Theatrical Press Agents and Managers

Brotherhood of Railway and Airline Clerks

Communications Workers of America

Federation of Professional Athletes

International Alliance of Theatrical Stage Employes and Moving Picture Machine Operators

International Association of Machinists

International Brotherhood of Electrical Workers

International Federation of Professional and Technical Engineers

International Union of Electrical, Radio and Machine Workers

International Union of Operating Engineers

International Union, United Automobile, Aerospace & Implement Workers of America

National Association of Broadcast Employees and Technicians

Office and Professional Employees International Union

Retail, Wholesale and Department Store Union

Screen Actors Guild

Seafarers International Union

Service Employees International Union

United Association of Journeymen Plumbers

United Food and Commercial Workers

Mr. WALGREN. Thank you. We will review those submissions for inclusion in the record.

Mr. Lundine.

Mr. LUNDINE. Well, thank you, Mr. Chairman.

These witnesses have raised so many points that it is hard to know where to begin. I guess if the measure of your productivity is being provocative, you have succeeded in being highly productive as well.

Dr. Birch, you made a conclusion that any job training or retraining programs had to have flexibility as opposed to uniformity. Dr. Lindsey went on and pointed out, I guess a little more philosophically than your presentation, that the great successes in America have had both central principles and decentralized decisionmaking.

Don't you think that in the adaptation of jobs to technology, maybe we need a little bit of both? While accepting the dynamic principles that you talked about, don't you think maybe we should set sort of an overall strategy for adapting the technology and then allow each area, even within States, as you point out, to adopt that to their particular needs or strengths?

Dr. BIRCH. I would like to have it go from the Federal Government down to the individual. I think one of the more interesting propositions around is the so-called individual training account which would be like an individual retirement account.

It becomes a form of occupational insurance where each individual would put, say, $250 a year into an account, a corporation would put in $250; the account would build up to a $6,000 pool any individual could use to retrain or relocate themselves or readjust themselves to shifts in the economy. It would be like a G.I. bill philosophically.

As a nation, we have to adjust and transform very rapidly. That has been the theme common to everything that has been said.

On the other hand, it puts the decisionmaking about how to do that with the individual company and employee. It leaps over the Government and puts it where it belongs.

It has nice implications for savings and for stability within the labor force. I think that kind of idea is an interesting one, one the Congress would consider very seriously. It has deep philosophical roots in terms of the ability of the individual to adjust—putting the decisionmaking in the hands of the individual, vested in that individual, and moving with that individual wherever that individual goes.

That kind of thing appeals to me a great deal.

Mr. LUNDINE. You answered two questions in one. My followup question was going to be, give me an example of that kind of training program.

Dr. Chamot, I don't usually get as nit-picky as to direct attention to a certain part of your testimony, and I want to say that if the bottom line of your testimony is everything that occurs at the end, I couldn't agree with it more. However, you have a statement at the top of page 235 in fact, two of them—that I found extraordinarily interesting. I think I don't agree with them.

You said it can be argued that all this new technology creates jobs in manufacturing, installation, maintenance, use of new equipment; this is true, but displacement is much greater. You go on to say if productivity increases faster than the growth in output, employment will drop. Can you prove that?

Dr. CHAMOT. I think the second is easier to prove because it is just straight mathematics. If you produce 100 widgets with 10 people, you have a productivity of 10 widgets per person per day, let's say.

If you install some new machines and double the output of each worker to 20 widgets per day, but you still manufacture 100 widgets per day, you need half the number of people, but your productivity has doubled.

If you have greater sales so that you sell more widgets, you will increase your overall output, but you still have an enormous deficit related to the productivity improvement that you have had.

It depends on the rate of productivity improvement. If the improvement is relatively slight, as many past improvements have been, it masks this result because you have also had it usually accompanied by output growth. But we have a sluggish economy now. Our output is not growing at very rapid rates, but the potential for productivity improvement is still enormous.

Mr. LUNDINE. But isn't it true that this is somewhat of a chicken and egg problem? I don't know if you were here for the previous panel?

Dr. CHAMOT. Yes.

Mr. LUNDINE. As Dr. Rosenberg pointed out, when Henry Ford reduced the cost of manufacturing a car, there were all sorts of thoughts that there would be terrible problems. The fact is that an increase in productivity allowed more people to buy cars. Isn't it possible that as you increase productivity, you will thereby create a greater market, particularly when we are in rather intensive international competition.

Dr. CHAMOT. In some cases you certainly will.

As I say, in the past that has been the experience. The problem that I have is looking throughout the economy and seeing Henry Fords everywhere I look. It is not just the auto industry. The banking industry and services are automating. Factories are automating. Warehouses are automating.

Checkout counters in supermarkets are automating. The communications industry is automating.

Mr. LUNDINE. That leads me to your first point. It seems to me that at a time of sluggish productivity that period has been the time when we have found greater displacement of workers, and it seems to me that there isn't a whole lot of evidence that it has really been the installation of the new technology that has caused the problem, but where we haven't installed new technology.

Whether you want to take Dr. Birch's example of comparing areas that have gone more high tech than to areas that haven't, or whatever other empirical evidence, it seems to me that the proposition is exactly the reverse.

Dr. CHAMOT. No.

As I say, I think in the past it might have been so in many specific areas. I think also we should not—as you are not doing—confuse the current economic problems of the Nation with technological displacement. It would be very difficult to pick out how many people who are unemployed today are unemployed because they have been replaced by a machine. Clearly the vast majority of the unemployed are unemployed because of a lousy economy, lousy economic decisionmaking and the like, very little related to technological displacement.

On the other hand, I would say there has been some technological displacement. What I fear is what is going to happen in the recovery.

In the automobile industry, both the company and unions recognized that a lot of people who are on layoff are permanently laid off. They will never come back because in this time of sluggish economic growth, the industry is still installing robots at a record rate, computerizing other aspects of manufacturing, computerizing their design systems and so forth, so that the output of the automotive industry is going to expand, but they are going to do it with fewer people than they had before.

Mr. **LUNDINE**. Exactly, but can't we see that the reverse has happened in the past? That it is possible that because they didn't install robots in the seventies that we lost jobs?

Dr. **CHAMOT**. Oh, absolutely. I think part of the problem again is a question of rate. The American automobile industry did not automate as rapidly as they should have. The unemployment problems are developing because it is all being done relatively instantaneously. If it were done all along, you would not have such a severe displacement problem.

The employment levels would have adjusted through better means as you went along.

I am not arguing here that the technological advances are to be avoided or that labor in general opposes technological change. This is not true. We do need to increase our productivity and in manufacturing and certain other areas we have to do that, utilizing some new technologies.

What I am saying though is that the technologies that are now becoming available are so enormously productive that we do have to be more concerned than we might have been in the past, that the economy is not going to automatically take care of all the people who need jobs.

Mr. **LUNDINE**. Mr. Chairman, I probably took too much time, but I didn't take half as much time as I wanted to. Thank you very much.

Dr. **CHAMOT**. May I comment on the question you asked the other two panelists about education and training?

Mr. **LUNDINE**. As far as I am concerned, sure.

Dr. **CHAMOT**. The first question I always ask when getting into discussions about training programs, retraining and the like is training for what?

Clearly we need flexible training programs, and a well-trained work force. Somebody mentioned earlier today the average worker is going to probably require retraining sveral times in a working lifetime, but we have 11 million people, unemployed now.

We have a lot of people who are so discouraged they are not counted. We have people working half-time or part-time jobs that would like full-time jobs. There is an enormous need for employment.

The greatest training program in the world does not necessarily create a lot of jobs. I think the big need now is to create the jobs and the training will probably to some extent take care of itself. I think there is a clear role for the Federal Government in the training area in that these training needs are going to be so enormous it is going to require a lot more coordination than we ever had before and certainly will require more money than is available now.

Mr. Lundine. Thank you.

Mr. Walgren. Thank you, Mr. Lundine.

Maybe I could just follow up on a couple of thoughts I have been having as you talked and then turn to Mr. Gephardt.

When you say create the jobs, Dr. Chamot, and the training will follow, to a certain extent I have had the feeling that we don't really know what to train people for.

One of the reasons our training programs politically disintegrate at some point in time is that they become criticized for not being effective when the truth of it is that, without the jobs there first, the training program cannot be effective.

Do you feel that we are in a position to carry out effective training programs on a governmental level?

Dr. Chamot. Oh, yes, certainly. I think, though, that the training programs, as you indicate, have to be tied to some degree of analysis of where the economy is going, where industries are going, and where jobs are developing.

I think, as again Mr. Lundine implied, there are two aspects of training. One is the broad general training that will result in a certain flexibility on the part of the worker.

The other is narrow specific job-oriented training for the purpose of performing a single specific job.

Certainly there is a role in this first case, starting with the elementary schools. We have allowed our public education system to deteriorate at a shameful rate. We have to reverse that. I think the fundamental need for a good flexible work force is a work force that has the basic educational skills of reading, writing, arithmetic, and communications.

Mr. Walgren. What about starting with Youngstown, Ohio? Is there a training program that can respond, that we can deliver, that is effective for the 50-year-old manual laborer who cannot participate in the thoughtware department?

Dr. Chamot. Well, there are a lot of jobs in our economy that are not very sophisticated in a technological sense. This will probably continue to be true for a very long time to come. Even in the example you mentioned of a 50-year-old person who has not been in the thoughtware industry, I think most people want to work, most people want meaning in their jobs.

I think most people would be willing to give it a try if presented with a proper opportunity.

But, even so, the BLS projections for the next decade still show that most job creation in the eighties is not going to be a high tech type of job.

They are going to be janitors, maids, service people, and low-skilled types of jobs. That doesn't answer your question directly. If you are asking, is there a kind of training program that would help people in a very depressed locality, the answer to that is probably no. It goes back to my first question: What are you going to train them for?

A training program in isolation is not necessarily going to do much good for anybody. It does have to be tied in with some sort of job creation. Perhaps direct Government job creation; perhaps bringing in private industry; probably a combination.

Mr. **Walgren**. Underlying that, in a way, is the difficulty that workers who have experienced relatively high wages have in going back to the wages that are available for a truly low-paying job. I know there are a number of young steelworker families in my area where, to support their family in any meaningful way, they do not feel that they should, at least in the best of possible worlds, and the world they expect the United States to be, to have to become that poor again, or to go that far back down the economic ladder in providing for their families.

How do training programs fit into that problem?

Dr. **Chamot**. The United Automobile Workers have negotiated major increases in company contributions to their jointly administered training funds in the last round of negotiations, I believe, with both General Motors and Ford in recognition of the fact that many of their members who are on layoff will never again find meaningful jobs in the auto industry.

The purpose of those jobs is to provide training programs to give people skills they could use in other industries. I think that is one way to approach it.

Mr. **Walgren**. What is the success rate?

Dr. **Chamot**. That I don't know. It is still very new. The economy is so depressed I really don't know what sort of placement rate they are going to have.

The real problem, as I see it, is jobs. There are not enough jobs, period. Anything else we talk about is secondary. Training is certainly a part of this. I don't want you to misunderstand me. Training is extremely important. As people switch from one industry to another, they certainly need retraining. Many jobs do require a certain high level of skill. That does require an extensive training program.

The problem is that the training cannot be looked at in isolation. It is not the kind of thing where we can develop a training program and say this is going to solve our unemployment problems.

The unemployment problems are not a result of people being improperly trained in most cases. It is a result of the fact we simply don't have enough jobs in a depressed economy. There are specific areas where there seem to be insufficient people available with particular skills, in some computer areas, for example. But the number of those jobs, compared to the total unemployed level, is very small. So the question is really one of how do we stimulate the economy? How do we create jobs? How do we get people back to work, and then, secondary to that, but still important, how do we provide the training that will be necessary for those people to function in those jobs?

Mr. **Walgren**. Mr. Gephardt.

Dr. **Gephardt**. I read your testimony. I apologize for not being present for your oral presentation. I really appreciate your being here for this most important day of the opening of these hearings. I think I would like to ask Dr. Birch a question, to begin. That is whether or not he believes that developing greater and better sources of information about both where jobs have been created in the past and trying to crystal ball gaze by doing field work and actually investigating where jobs might be in the future, where growth in jobs will be in different communities in the future, is something that we really need to address first as a threshold before we even address the policy options that are before us.

And is this very easy to do? How costly is this exercise, if we really think it is important to do on a nationwide basis?

I am just struck by some of the statements that you made in your testimony, some of the statements that Dr. Chamot has made. There is a real disagreement, I think. It is not just you two.

I think there is vast disagreement across our whole society among observers who are really looking at this data, looking at what is happening.

I just wonder if you don't think—and I would be happy to hear both your comments—that we don't have to do a much better job of understanding the facts before we can have any kind of real consensus on what the policy options are?

Dr. BIRCH. I think there is a step before understanding the facts. That is continuing to collect them. The present administration has not done wonders for data collection itself. Many programs have been cut back within the Bureau of Labor Statistics—a lot of survey work. Everywhere you go, they have been pulling back from measuring what is going on at a time when I think we need it more. That is step No. 1. The census is getting later and later and coming out with less and less and less. I think the whole process of measuring is deteriorating.

Mr. GEPHARDT. Can you identify specific places where that information flow has been curtailed?

Dr. BIRCH. Right now?

Mr. GEPHARDT. Later for the record.

Dr. BIRCH. There is a process we are starting in the State of Connecticut, which I think will be interesting. We are digging in great detail through field work and interview work with corporate personnel people, corporate labor planners, labor people, to get a sense of not only what jobs will be there, not only what the occupations will be, but what the skill content of those jobs will be. What will a secretary be doing 5 years from now? What about a telecommunications clerk? What kind of skill content will those jobs have? We will then take that back to the educational institutions and say how we want you to train secretaries.

I was interviewing a graduate of a secretarial school the other day. They only have 4 hours of word processing time when they graduate. That is appalling, given what is happening in the world. There is a need to get the perceptions of the educational institutions up to speed with what is going on in the economy.

I think they are falling further and further behind rather than getting ahead. We need to make skill projections as well as occupational projections.

The Congress has the vocational authorization before you this year. That is a major opportunity I think, if properly designed, to force the educational system to rethink its charter.

It has become very fractured, very parochial in its design. The legislation is about homemakers, Indians, and all sorts of other constituencies. I am for them, but it doesn't seem to be the starting place for thinking about the future of vocational education in this country.

The starting point is where are the jobs going to be, what are the skill needs?

Before I handed out funds from that legislation, I would want the recipient to tell me exactly where they stand, where the skill needs will be, how they will go from where they are to where they want to be.

That legislation is before you right now at this point.

Mr. GEPHARDT. You think that should be done on a State by State basis, or do you think that is a responsibility that rests here?

Dr. BIRCH. I think you tend to hand out the funds on a formula basis. Therefore, they get fractured.

Given the diversity between States now, I think you are going to have to start acknowledging differences.

Minnesota has become very interested in looking ahead this way. Connecticut has. Tennessee has. Some are way ahead of others. I think it would be very difficult for the Federal Government to get a handle on the diversity that is around. I think you have to go to the State level and demand forward-thinking on the part of the States.

I know many States are ready to do that and would respond and others would have difficulty.

Mr. GEPHARDT. Could you supply for the record how many States you think are engaged now in an active effort to gain that information?

Dr. BIRCH. I can tell you the ones I know about. There are others I am sure I don't know about.

I would be happy to describe the ones I am familiar with.

Mr. GEPHARDT. One other question. That really goes to this question of macro and micro and how Europe did it, how you see us doing it, and then the comments the other two speakers made.

I guess with regard to job creation your point is that we have made a lot of progress because in your view we haven't had a micro policy. I would like you to comment on that. Do you think we have made more progress in job churning, in change, than other economies because we have failed to have a micro policy? We have failed to have as much of a safety net?

We do not have plant closing legislation or other kinds of things which retard that process? Rather than having an affirmative macro or micro policy? Is that what you are saying? Are you prescribing—is your idea that we ought to try as much as we can to avoid a micro policy so we can allow that churning to happen? To the extent we can allow it to happen?

I would like the other speakers' views on that.

Dr. BIRCH. I think the answer to that is yes. My friends within the trade union movement don't always agree with me on this. I think one of our great strengths as a nation has been our volatility at the micro level, the churning, the adaptiveness we have in the system.

I spend time in England, Sweden, Holland, and other nations which have a much greater rigidity in terms of jobs and corporations.

They pay an enormous price for that in terms of the ability to adapt their economies over time. I think you can trace a great deal of the problems of Holland to just that inability to adjust quickly.

On the other hand, what concerns me greatly is that our micro instability has created an enormous displacement problem for relatively small groups of workers. We have 10 percent of the American labor force who actually make anything. If 10 percent of those are unemployed, we are talking about 1 percent of the labor force. Yet they are wreaking political havoc with many State legislatures and the Federal Government. And justifiably so, because we have been so inhumane about the way we deal with displacement as it occurs.

The Swedes are enormously humane. The problem is, they have built rigidity into their system to get there. I think we have to deal with our problem not by building more rigidity into the system, but by putting more humanity into it.

I don't think we should try to copy Sweden, Denmark, Holland, the United Kingdom. I think we should do it in our own way, which would be giving the individual more ability to relocate, retrain, and become more mobile in our system. That is our way of dealing with our problem. I think it will be much more effective than, say, the European model.

My fear is we would try to copy the European model.

Mr. **Gephardt**. Dr. Chamot.

Dr. **Chamot**. One of the problems with looking to a foreign experience—which I recommend, by the way—but one of the problems is not to look at snapshots. If we looked at the situation only a few years ago, we would say Germany and Sweden were doing remarkably better than the United States. It is only when the world economy went sour they started to have problems.

Everybody talks about Japan. It is interesting to me to see the effect of the Japanese system of lifetime job security, which, by the way, applies only to about 30 percent of their work force. In those companies that practice that policy, they are required to be very innovative. If you are a manager of a corporation and you employ large numbers of people and see the life cycle of a product is starting to taper off, you are going to start looking around very quickly for other businesses to get into to keep those people employed.

The Japanese have been incredibly inventive. They have had a very rapidly growing economy. In the United States on the micro level, individual companies can shut plants that are not meeting profit targets, or can try to increase prices if output is not expanding enough to generate the profits that they want, and the results have been dismal.

So I think there is a lot to be learned from the international scene, and while I would say that there is not one other country whose system could be adopted wholly in the United States, I am sure there are lots of bits and pieces that we could learn from.

Mr. **Gephardt**. One last question. We are going to have a session on demographics. What little I know about it, at least indicates that we are liable to have a labor shortage by the end of the decade because of the baby bust beginning about 1962. I would like to know if you see that on the horizon or if you think that is an illusion?

Dr. **Birch**. One of the things we do know is that the growth of the labor force is slowing down very substantially. We expanded about 25 percent in the last 2 years. We are expected to expand 15 percent in the next 10. That could probably slow down even further. So that, in fact, our job growth is slowing down. Whether or not we have a labor shortage will depend a great deal on the participation rate. We have expanded the number of people who want to work relative to the size of the adult population. If that continues, and we go to more and more women, elderly people, younger people, and job-sharing, we could continue to expand the labor force considerably.

On the other hand, if there is a retrenchment from that, we could end up with a real shortage—if people want to pull back out and lead a more traditional life. I think it will be cultural as much as anything else.

Dr. **Chamot**. I am not sure what the future is going to bring. Our population may be slowing down and the baby boom is passing, but that is only one side of the coin.

One of the problems that I still have is the question of technological change. I don't know how Professor Klein, for example, and Wharton Econometrics, includes technological change in their forecasts. I have spoken with some people at Georgia Tech that are trying to do this and in very crude ways they come up with enormous unemployment rates over the next several decades because of widespread use of technological change.

They may not be correct. Wharton Econometrics may not be correct. We don't know what is going to happen. That, I think, is the big unanswerable. The technologies we are talking about are so enormously productive. It is going to depend upon how they are applied, how rapidly they are applied, and where they are applied, and even with the population growth rate slowing and the work force growth rate possibly slowing, if the productivity increases that everybody desires really start to take off, we still could have severe problems.

Mr. **Gephardt**. I think that covers our questions. Certainly we appreciate the commitment of time all of you have made to be here this morning. You have been extremely helpful in launching these hearings. We look forward to six more productive sessions.

We invite you to review the record of this hearing when it is completley finished and perhaps after it is finished at some point in the future we might be enticed to bring you back and have you review what you said in light of all the things we will hear at the next six sessions.

Thank you very much.

The hearing is adjourned until Thursday at 9:30.

[Whereupon, at 12:15 p.m., the subcommittee and task force adjourned, to reconvene at 9:30 a.m., Thursday, June 9, 1983.]

TECHNOLOGY AND EMPLOYMENT

THURSDAY, JUNE 9, 1983

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY; SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY, AND THE COMMITTEE ON THE BUDGET, TASK FORCE ON EDUCATION AND EMPLOYMENT,
Washington, D.C.

The subcommittee and task force met, pursuant to call, at 9:30 a.m., in room 2255, Rayburn House Office Building, Hon. Doug Walgren (chairman of the Subcommittee on Science, Research and Technology) presiding.

Present: Representatives Walgren, Gephardt, MacKay, Boehlert, Sensenbrenner, and Skeen.

Mr. WALGREN. Let me call us to order. We should start.

The first witness today is the Honorable Berkley Bedell, a Representative from Iowa, who has been active on the issue of the impact of technology on unemployment through his work on the Small Business Committee and a subcommittee thereon which he chairs.

We are particularly pleased to welcome you, Berkley. We hope that by our joint efforts with the relationships that flow from the Budget Committee and the interest on the task force there and the relationships that flow out of the Science and Technology Committee, we can expand the sensitivity to this subject. Part of this effect is trying to involve all those that have worked on the subject as you have.

We would very much appreciate your contributing to this record, and we want to involve you in what we might be able to do in every way we possibly can.

Thank you very much for coming. Please proceed as you will.

Perhaps before we do that I ought to just give my cochairman an opportunity to welcome you.

Mr. GEPHARDT. I would echo Doug's remarks and thank you for taking the time to come here today. We are very pleased that you have done so much work in this area. One of the things we hope to do is benefit from all that has gone on in the Congress before this time in the same pursuit of knowledge in this area.

We look forward today to your testimony. Thank you for taking the time to come here.

[The biographical sketch of the Honorable Berkley Bedell follows:]

BERKLEY WARREN BEDELL, Democrat, of Spirit Lake, Iowa; born March 5, 1921, in Spirit Lake; attended Spirit Lake public schools, graduated from Spirit Lake Community High School, 1939; attended Iowa State University, 1940-42; served as first lieutenant U.S. Army Air Force, 1942-45; president, Spirit Lake Kiwanis Club, 1956; president, Dickinson County Memorial Hospital Association, 1964-66; Nation's Small Businessman of the Year, 1964; associate lay leader for lay life and work, Iowa Conference, United Methodist Church, 1971-74; Spirit Lake Citizen of the Year, 1965; member, Spirit Lake Board of Education, 1957-62; organizer and first president of Iowa Great Lakes Student Loan Fund; secretary, Morningside College Board of Directors; secretary, Iowa Manufacturing Association; member: Methodist Church, Kiwanis, Izaak Walton League, Masonic Lodge, and numerous other civic organizations; married the former Elinor Healy, 1943; three children: Kenneth, Tom, and Joanne; elected to the 94th Congress, November 5, 1974; reelected to each succeeding Congress.

STATEMENT OF HON. BERKLEY BEDELL, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF IOWA

Mr. BEDELL. I want to thank both of you for this opportunity. I want to commend you for the efforts you are putting forth to try to look into this issue. I guess I wouldn't really feel right testifying if I didn't tell you that the two of you are two of the people that I most admire among all of my colleagues. I think a great deal of both of you.

I am just delighted that you are the ones who are leading some of this effort to try to pursue knowledge in trying to find answers to some of these questions.

The reason I asked to testify is that, because of some of the concerns I have had, I took a special small business subcommittee which was renamed—the Committee on Oversight and the Economy—in order that I could have some staff on that subcommittee to specifically investigate the problem that we may well face in our society with continuing high unemployment.

I have a concern that is that things may indeed be different at this time than they have been in the past, and the changes we are seeing may be quite different from those we have seen in the past.

The time was when it took 75 percent of our people to produce our agricultural products. We are down now to where it is less than 3 percent. I think we are going through that same change now in regard to the production and distribution of the goods in our society. Whereas the people that left the farms were able to get jobs building automobiles or refrigerators or tractors or whatever else it may have been, it appears to me that there is a great question as to whether there are going to be opportunities for those people being replaced at this time with robots and computers and automation to go to other places, because the automation that is taking place on the automobile production line is not just taking place therein; it is taking place throughout our whole society.

So, the futurists would tell you we are going to move from a manufacturing society to an information society or a communications age, but if you talk to the people at AT&T you find out they also are cutting down on their employment because computers are automating that area as well.

I have some prepared testimony which I will leave on the table for those that are interested. I would like to go through it, if I might, because it applies to some of the concerns I have.

I hope that you would not perceive me as predicting what is going to happen, but I hope you would perceive me as questioning those who say this or that is going to happen because I believe there is good reason to question many of their statements.

For example, a Nobel laureate, Lawrence Klein, testified before this joint hearing earlier this week and reassured you that unemployment is merely cyclical and would be reduced to 5 or 6 percent by 1991. I hope that is correct, but I am deeply troubled by some of the ways he reaches his optimistic predictions.

I believe technological and managerial innovation and international competition raises serious questions about some of his assumptions. We should look at projections for every job category, but let me this morning draw your attention to the area we know best and have responsibility for, government employment.

Mr. Klein's Wharton Model projects a 14.6-percent increase in overall government employment by 1991. That is, he projects 2,300,000 new government jobs, a 15-percent increase in Federal Government employment and a 14.5-percent increase in State and local government.

Of course, our recent experience is quite different. In the past 2 years Federal employment has not increased but decreased by almost a full percentage point reducing overall Federal employment by 27,000 workers; more importantly, in terms of aggregate numbers, State and local employment over the past 2 years has declined by a full 5 percent, reducing overall State and local employment by 685,000 workers.

The decline in Federal and State and local employment is continuing, although at a slower pace in most areas of our country.

I, myself, doubt very seriously that government employment, as we currently define that category, will be anywhere near the levels Dr. Klein projects by 1991.

The Wharton Model is certainly not alone in the use of highly questionable assumptions. The Bureau of Labor Statistics, the leading authority in these matters, projects that the largest number of new jobs in the next decade will be for secretaries. Typists, I might add, are also seen as a major growth occupation. Anyone familiar with the rate and extent of recent office automation would have to be perplexed by these projections.

The problem that I have with the Bureau of Labor Statistics projections is that since they are the only people who really gather figures as to what has happened in the past, they are the authorities.

So we, therefore, accept them as the authorities of what is going to happen in the future, and when we had a futurist before our committee and he told us what would happen, I said, where did you get those assumptions and he said, from the Bureau of Labor Statistics.

If we are correct, changes are taking place that are different from those that have been in the past. Then if we are going to project what is going to happen based upon what has happened in the past, as does the Bureau of Labor Statistics, certainly we have to question whether we are going to create more jobs for secretaries than any other area of our society.

At least one of the witnesses we had before us just shook her head as she sat in the audience. When she came to testify I said, do you agree with that? She said, no, in our business we have eliminated secretaries completely because of the new automation.

Examples are legion. The occupation of draftsmen is also projected by the Bureau of Labor Statistics to create 9,000 to 13,000 new jobs each year. Engineers, such as we had in our hearings last month, however, believe that technological advances in computer-aided design, CAD, it is called, is already drastically reducing and will soon nearly eliminate the need for draftsmen.

I am not an engineer, but I believe there is reason to question such projections.

So you understand why I am concerned. My concern is that our current employment problem may not be merely cyclical. Economic cycles have been with us for some time, of course, but below the cycles a more fundamental structural change has taken place.

Past technological innovation has changed us from an agricultural to industrial and some years ago to a service economy. The American economy has provided 30 million new jobs since 1965, almost all of them in the service sectors and in white collar employment. This is seen as proof of adaptability by many economists and some government officials, but it is seen as a major reason for competitive decline by most businessmen and women. Company after company from Firestone to GE are now cutting back on middle management. Employment companies are very conscientiously becoming leaner, more fluid, and with fewer levels of management.

Many of our new technologies are specifically targeted at labor-saving in the service sectors. Productivity is becoming the key to survival not merely success in all sectors of our economy.

Where will the innovation of the 1980's and beyond lead us? Will technological innovation lead us into an affluent and bountiful society? This certainly should be the case.

We now have almost as much overcapacity to produce food and goods for our people as we have overcapacity to exterminate all life on the Earth. But real GNP growth for the past 4 years has been only 0.6 percent and unemployment has risen to above 10 percent, even with flat productivity growth.

Productivity is now increasing rapidly, as it must, in order to compete in the international market. But estimates of one of our witnesses last month are that even with the most modest productivity growth at 1.5 percent through the end of the decade, it would require sustained real GNP growth of more than 2.7 percent just to keep the unemployment rate below 14 percent.

Higher productivity growth he testified would require significantly higher GNP growth or we would face unemployment rates which could well reach 14 percent and higher.

I am not here to predict this, Mr. Chairman, but I believe we should be very, very careful that we do not simply accept, particularly the figures of the Bureau of Labor Statistics, and say we have nothing to worry about because in the past we have created new jobs as we have replaced people through labor-saving devices in view of the fact that there certainly is some reason to believe maybe we are going through a different change today than we did in the past.

I would hope that as this committee looks at it that we would at least not close our minds to the possible concerns that I believe are legitimate concerns in this area.

[The prepared statement of Mr. Bedell follows:]

REMARKS BY HON. BERKLEY BEDELL BEFORE THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY AND THE HOUSE BUDGET COMMITTEE, TASK FORCE ON EDUCATION AND EMPLOYMENT

Nobel Laureate Lawrence Klein testified before this joint hearing earlier this week and reassured you that unemployment was merely cyclical and would be reduced to 5 or 6 percent by 1991. I certainly hope that Dr. Klein is correct, but I am deeply troubled by the way he arrives at his optimistic projections.

I believe that technological and managerial innovation, and international competition, raise serious questions about the assumptions behind Dr. Klein's numbers.

We should look at projections for every job category, but let me this morning draw your attention to the area we know best and have responsibility for: government employment.

Dr. Klein's Wharton model projects a 14.6 percent increase in overall government employment by 1991. That is, he projects 2,300,000 new government jobs: a 15 percent increase in Federal government employment and a 14.5 percent increase in State and Local employment.

Of course, our recent experience has been very different. In the past two years Federal employment has not increased but decreased by almost a full percentage point: reducing overall Federal employment by 27,000 workers.

More importantly, in terms of aggregate numbers, State and Local employment over the past two years has declined by a full 5 percent; reducing overall State and Local employment by 685,000 workers.

The decline in Federal and State and Local employment is continuing, although at a slower pace in most areas of our country.

However, I myself doubt very seriously that government employment (as we currently define that category) will be anywhere near the levels Dr. Klein projects by 1991.

The Wharton Model is certainly not alone in the use of highly questionable assumptions. The Bureau of Labor Statistics, the leading authority in these matters, projects that the largest number of new jobs in the next decade will be for secretaries! Typists, I might add, are also seen as a major growth occupation. Anyone familiar with the rate of recent office automation would have to be perplexed by these projections.

Examples are legion: the occupation of Draftsman is also projected by BLS to create 9-13,000 new jobs each year. Engineers such as we had in our hearings last month, however, believe that technological advances in Computer-aided design (CAD) is already drastically reducing—and will soon nearly eliminate—the need for Draftsmen. Now I am not an engineer, but I believe there is reason to question such projections.

So you understand the reasons for my concern.

My concern is that our current employment problems may not be merely cyclical. Economic cycles have been with us for some time of course, but below the cycles a more fundamental, structural change has taken place. Past technological innovation has changed us from an agricultural to an industrial, and then some years ago, to a service economy.

The American economy has provided 30 million new jobs since 1965: almost all of them in the Services sectors, and in white-collar employment.

This is seen as a sign of our adaptability by many economists and some government officials. But it is seen as a major reason for our competitive decline by most businessmen and women. Company after company, from Firestone to GE, are now cutting back on middle management. Employing companies are very consciously becoming leaner, more fluid, and with fewer levels of management.

Many of our new technologies are specifically targeted at saving labor in the services sectors. Productivity is becoming the key to survival—not merely success—in all sectors of our economy.

Where will the innovations of the 1980s—and beyond—lead us?

Will technological innovation lead us into an affluent and bountiful society? This certainly should be the case. We now have almost as much overcapacity to produce food and goods for our people as we have overcapacity to exterminate all life on earth.

But real GNP growth for the past years has been only 0.6 percent and unemployment has risen to above 10 percent even with flat productivity growth. Productivity is now increasing rapidly—as it must in order to compete in an international market. But estimates of one of our witnesses last month are that even with the most modest productivity growth of 1.5 percent through the end of the decade, it would require sustained real GNP growth of more than 2.7 percent just to keep the unemployment rate below 11 percent. Higher productivity growth would require significantly higher real GNP growth or we would face unemployment rates which could well reach 14 percent and higher.

Mr. **Walgren**. I would like to say in response I think that is a most crucial contribution—the questioning of the assumptions of the futurists which I did not have a grasp of yesterday or the day before when we heard the futurists.

It leads me to recommend perhaps we may have a way of going back to those who testified on Tuesday and ask more about the assumptions underneath the graphs they were using to project. I think it would be only fair to underscore that neither of them was very concretely positive about questions on future employment.

In response to questions on that, they did not strongly assert a firm belief that employment would be maintained; and there may be some very good questions that we can ask about where the data from the Wharton model comes from and what kinds of input there is to that.

I would like, if the other members would permit, to underscore another point you make by an anecdote that really has stuck in my mind. The kind of change we are going through is very different from everything else and has been likened to the introduction of the tractor to agriculture which, in our experience, was one of the most devastating changes in labor we have experienced since the industrial revolution. But the person telling that anecdote completed it by saying that when they brought the tractors onto the farms, nobody really asked how many unemployed horses there were. The problem is, right as you put your finger on it, that there may be no place for these people to go if the industrial or manufacturing sector is full. So I just want to say how much I appreciate your testimony at this point in these hearings.

Mr. **Bedell**. Thank you.

Mr. **Walgren**. Mr. Gephardt.

Mr. **Gephardt**. Let me follow on. I completely share your concern and I think one of the main reasons that I have wanted to be involved in this effort was to try to excite some interest in the Congress and outside the Congress in trying to improve our base of information about both the past and certainly the future.

In private conversations I have had with Dr. Klein and others, I think there is a shared understanding that the information base we have got, certainly about the future and probably about the past, is inadequate.

I am not going to talk for Dr. Klein, but I think one of his hopes is that in the future we can find ways to make better projections.

I think he is as frustrated as you are and as I am with the ability we have today to try to predict the level of employment both within categories and in aggregate form.

I think he would share your views about what even he said and about the adequacy of his forecast.

One of the reasons that I felt it was important to have these hearings was to highlight the fact—which you made crystal clear—that the data base that we have, the information we have, is inadequate and that the Bureau of Labor Statistics, perhaps in many cases not by their own design, has not been able to be very creative in trying to develop the information we need.

One of the other witnesses we had, David Birch, made the point that the budget of the Bureau has been cut in areas where they were trying to be more innovative, to try to create better information.

He also believes and said that a lot of new work is going on at the State level in some few States to try to develop better future information.

Part of it is that you have to get out of Washington, and you have to get out in the field; you have to talk to people about what is happening, get away from the computer. You have to get better and newer and more definitive information into the computer to get better answers out of the computer about what is going to happen.

I think he made that point very well. I think your statement is well taken, well appreciated, right on the money, exactly in agreement with what we think, but it helps to have it buttressed by somebody who has been looking at this longer than we have.

I deeply appreciate your coming here and saying it. I hope that we can work with you in the future to try to develop better information and do better forecasting about where we are going so that we can begin to make better decisions about how to create the kind of employment base we need.

I think everybody agrees the country needs that.

Mr. BEDELL. I certainly did not mean to be critical of Dr. Klein personally. I mean to talk about the whole issue. If I might tell you, the Bureau of Labor Statistics, in their information, tells the following occupations count for 50 percent of all new jobs generated in the 1980's.

The one generating the most, as I think I indicated, was secretaries. Included in their list are such things as sales clerks. It appears to me we are automating our sales as well. Elementary school teachers. They tell us the baby boom is over. This is another major place where there will be a big increase.

Blue collar worker supervisors. At least most people would tell you with the coming of the automation that it requires fewer supervisors and certainly as we move toward what Japan is doing, it requires fewer. I have already indicated typists as one of those; stock clerks and stockroom and warehouse. That is all being automated, as we see it happening. Bank tellers. We are seeing this automated as well.

Maybe these are legitimate projections. When I try to say what I am saying here among futurists, they laugh at me and say, Berk, we have heard that through the ages. You don't know what you are talking about.

You talk about getting out among the people. I can tell you when you talk to the people about this, they say, gee, anybody ought to say this is indeed a legitimate concern.

Mr. **GEPHARDT**. There are two other factors you are obviously aware of that we are hopefully going to investigate more fully in these hearings. One is the potential for greater growth which you talked about at the end of your statement.

What is the potential for new areas of the economy that we don't even yet understand to make that growth factor greater?

The second obvious factor is demographics; how many people are there going to be that we are trying to deal with? There is disagreement on that. Some people say we are going to have a labor shortage. I don't know what their projections are of how many jobs there will be, but some people talk about labor shortage because of the baby bust beginning in about 1962. Even with the women coming in at 50 percent, those are all things we have to look at in trying to figure this out.

I share your concerns about the pat answers that sometimes we have been willing to take.

Mr. **BEDELL**. Does it make sense if we are going to have a baby bust that we are going to have a big increase in elementary school teachers?

Mr. **GEPHARDT**. I doubt it.

Mr. **BEDELL**. That is the 11th highest of all occupations according to the BLS in how many more people will be needed. We will need 251,000 more.

Mr. **GEPHARDT**. We may need teachers. They may not be elementary school teachers. They may be retraining teachers.

Mr. **WALGREN**. Let me recognize other members.

Mr. Skeen.

Mr. **SKEEN**. I am sorry I was late, Mr. Chairman.

This is a very interesting thing. I read the statement by Mr. Bedell. I have great respect for him. We share a lot of concerns about employment.

I think that the tone you take in your testimony is very interesting because, using as a frame of reference Dr. Klein's statement the other day was a scientist's view of the data that he had to interpret, and it is not always the only view—I think he took one that was the positive or optimistic view.

That is good. I think it is an element we need to look at.

We can't always look at the dark side of things. I don't think your statement reflects that; yours is more the pragmatic view of this thing. I appreciate that very much. I think between the two we are trying desperately to grapple with where we are going. We know that we have a fundamental structural change in employment in the United States, but we have experienced that because we are a country that accepts change much easier than many other countries.

We are not the so-called traditionalists. We are only 200 years old. That is a very small span of time. We have probably had more influence on changing employment patterns throughout the world because of the way we live.

Unfortunately, though, it stereotypes our own type of thinking. What you are pointing out is that we shouldn't be stereotyped in the way we think. The curves were very interesting that Dr. Klein had. I think the statistics he brought to us the other day were very interesting insofar as a collation of material that is a good data base to start working from.

There were interesting things about the curves, the upswings, the downswings, employment, output, getting very close to each other; whereas, on the upside of the curves, the output far exceeds the employment.

But, on the downside they stay very close. It is characteristics of this kind that are extremely important. I think you put your finger on what is happening here that is you can't overlook the fact there are *structural changes.* We are not going to have a great many young people in elementary schools sometime in the future, so there wouldn't be a great deal of point in urging a lot of career-oriented people now who have been going into the system to train themselves to be elementary teachers if they can't find employment.

I am always amazed at the number of stenographers we say we are going to need. That is vastly overestimated because I think that, as you pointed out, automation is going to take its toll there.

Somewhere in between these two outlooks we have to come up with some answers of how do we better utilize the data that we have got.

How do we prepare young people or advise them on where they should be pointing themselves as far as careers are concerned?

So I think that is the real power of these kinds of hearings. I appreciate your input very much. I think it is a very important element of it. It gives one again, as I mentioned the other day to the chairman—the cochairmen here—that the nice part about these hearings is that we give a little bit of time in between the panels allowing us to kind of mull these things over.

It removes a lot of mind sets. So, with that said—probably redundant as it may be—I still appreciate the fact that we are having these hearings. I think everybody does. Your participation is extremely valuable. Your point is well taken.

Mr. WALGREN. Thank you, Mr. Skeen.

Mr. Boehlert.

Mr. BOEHLERT. No questions.

I would like to thank Mr. Bedell for a very helpful statement. It shows you are in touch with the real world. So often in this town people aren't. I thank you for it.

Mr. WALGREN. Going back to the graphs that were presented the day before yesterday, I was thinking about them afterward. Although on the one hand they look relatively optimistic because there's a lot of times that the lines are going up, it is also, I think, important to think about when you look at these graphs that everything below the median point is simply—those lines that are rising, even though they are below the median point--is a lessening of the decrease in employment and production, not a net increase in employment and production.

So, everything below the median point can be described as pretty difficult times with respect to the direction of employment. Employment is getting worse at all points below the median point. It is just that the rate of getting worse is lessening as you rise out of these bottom points.

It seems to me that when you consider that, the graphs become a little less optimistic about the shape of our economy at all times represented by those lines.

Mr. **Skeen**. Will the chairman yield?

Mr. **Walgren**. I will be happy to yield.

Mr. **Skeen**. I think that is a very cogent observation. Of course, other characteristics on the graphs were interesting too.

In the services category, they tend to cycle much less sharply, and they stay steadier, which is, I think, an indicator of what we have been talking about.

Service industries are going to be those that are very important to us in the employment picture of the future. But I do want to say this, as far as arguing whether we ought to be optimistic or pessimistic, we probably ought to get our graph somewhere on the average and read this as "No matter how bad it is, we have to deal with it."

We know it is a problem. It is like a golf game. We know where the ball is, so let's play the ball where it lies.

I think we have hashed over the graphs. I was very interested in them. They gave me a lot of meat for thought or food for thought.

Mr. **Bedell**. I don't think the issue is whether you are optimistic or pessimistic. I think the issue is, do you plan for whatever may be coming forth in the future?

If you don't consider the other possibilities, then I think your planning has not been adequate and I think you need to plan on what you are going to do if things do not turn out as you hoped they would, and also plan for what you will do if they do turn out the way you thought they would.

Mr. **Boehlert**. It is not optimism or pessimism. It is realism. I think your statement signifies realism. I was disappointed with Dr. Klein. I didn't see a category for video-game repairmen. I think that is the biggest area for the future.

Mr. **Walgren**. And training of Air Force recruits thereon.

May I extend an invitation to you to join the committee? We would love your participation. These hearings are open to you if you have the time to sit with us and pursue some of these thoughts with us.

Mr. **Bedell**. I appreciate that very much, Mr. Chairman. Indeed, I might. We have a vote now.

Mr. **Walgren**. Well, we have a vote on the floor. Unless people want to continue through that, I think I would leave that to you.

Mr. **Gephardt**. Let's go vote.

Mr. **Walgren**. When we come back we will start with the first panel. I want to say at the outset, that we are going to follow a 10-minute rule in terms of the presentations. We worked out a light system which will trigger a red light after 10 minutes have gone by. So those who are presenting know that that is a signal that if we go on for much longer, we do cut into the time that the members have to pursue some tangents with you as witnesses that might be very helpful to them.

We ought to try to stay within that.

We will be back in 15 minutes.

[Recess.]

Mr. MacKay [presiding]. Ladies and gentlemen, I will call the meeting back to order and ask Mr. Lund, Dr. Hirschhorn, and Mr. Howard if they will come up.

On behalf of the respective chairmen of the subcommittees, I would like to apologize for the institutionalized chaos and ask if each of you would go forward under the ground rules that have been stated? We will operate a timing mechanism and as nearly as possible try to adhere to the 10-minute limit on the prepared testimony.

I expect the other persons who have been here to be back in time so the questioning will be a meaningful thing. It will be meaningful for me in any event, but I know you would like to have as much participation as possible.

If that is acceptable, we will start with Mr. Lund.

[The biographical sketch of Mr. Lund follows:]

BIOGRAPHICAL SKETCH

ROBERT T. LUND

Robert T. Lund is Senior Research Associate and Assistant Director of the Center for Policy Alternatives and Senior Lecturer in the Department of Mechanical Engineering at Massachusetts Institute of Technology. Mr. Lund has had an extensive career in both industry and academia. Following his education at Harvard College and Harvard Business School, Mr. Lund spent the first twenty years of his professional career in engineering and manufacturing management positions related to consumer, industrial and military products. In 1970, he was asked to join the faculty of Harvard Business School to teach production and operations management. In 1972 he joined the newly-formed Center for Policy Alternatives at MIT. Since then he has directed research in the areas of manufacturing policy, industrial automation effects, technology transfer, consumer product policy, product life, and remanufacturing. These studies have produced 25 reports and books over the past eleven years.

In addition to his research, Mr. Lund teaches two courses at MIT -- Elements of Manufacturing and Management in Engineering, and he is a consultant to industry and government. His long-standing interest in the human consequences of technological change stems from his work in industry, and he has directed a series of studies on issues in this area. His interest in the extension of product life has resulted in the first comprehensive examination of remanufacturing activities in this country.

August 15, 1983

STATEMENTS OF ROBERT T. LUND, ASSISTANT DIRECTOR, CENTER FOR POLICY ALTERNATIVES, MIT; DR. JOEL S. HIRSCHHORN, PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT; AND TIMOTHY HOWARD, VICE PRESIDENT AND CHIEF ECONOMIST, FEDERAL NATIONAL MORTGAGE ASSOCIATION

Mr. LUND. I want to thank the members of this subcommittee and task force for inviting me to be here this morning. I have two substantially different subjects to discuss, but each relates in its own way to the questions before your subcommittee and task force.

The first subject has to do with future manufacturing technologies that will have major consequences for the industrial work force. I will discuss the results of a recently completed study of emerging technologies, the issues raised by their adoption and suggested policies to maximize the benefits they promise.

The second subject concerns remanufacturing, a little-understood industrial activity that has much to offer our economy, especially in difficult times.

Both of these subjects are large and somewhat complex. Because I cannot do justice to either in the brief time available, I have prepared statements for your consideration and for inclusion in the written record. My comments here will merely touch on a few major points.

With respect to future technologies and their consequences, the first essential fact is that we are moving into an age in which virtually all industrial activities will be dominated by two key technologies, really megatechnologies. These are the integration of computers into industrial processes and the adoption of new telecommunications technology.

For the next decade, no other technology will even approach the importance of these two.

Both of these megatechnologies serve to integrate machines, people, and information systems into efficient productive units. Both are as broadly applicable to traditional manufacturing operations as they are applicable to new endeavors.

Even more important, in terms of hopeful prospects for our economy, these two giant technologies are converging. We are now seeing important new products that are the result of innovative combinations of computer and communications technology. We will see even more in the future. As I mention in my paper, telephones are beginning to look like television sets and act like computers. The potential for new products arising from the combination of the two technologies is enormous. The contributions made by other new technologies such as electron beams, lasers, acoustics, or pattern recognition will serve to augment this potential.

The advent of these megatechnologies is not an unmixed blessing. Unless industrial practices and policies change, the effects of technological change will be troublesome for many people at various levels in industry and government. Some of the thorny issues ahead include:

First, substantial displacement of employees from jobs that are eliminated or changed in nature by new technology.

Second, significant changes in the skills required of people working in connection with processes controlled by computers and linked to communications networks.

Third, a "pinching-in" of organizational structures at two levels in the firm. Within the blue collar category, major reductions will occur in moderately skilled jobs such as those of machine operator, welder, painter, inspector, and assembler. A second restructuring will occur through the thinning out of staff specialists and middle managers in the white-collar ranks.

Fourth, the major changes in the distribution of jobs just cited may cause a further complication. If gaps appear in the series of jobs through which people normally progress to higher paying, higher skill jobs, we may begin to see a stratification of the labor force. This could produce frustrations, anger and alienation.

Fifth, displacements, skills changes, organizational changes, and barriers to advancement can all be sources of resistance to change. If the resistance to change is sufficiently great, the gains promised by the megatechnologies will not materialize.

When considering what to do about these potential difficulties, it will be useful to keep two things in mind. First, people act openly, responsively and cooperatively when they act from a base of personal security. If the level of security for each person in the work force can be raised, progress toward industrial revitalization will be promoted.

Government policies can relieve some of the problems associated with individual security. Lifetime employment is not a way of life in American industry, and job changes from one company to another are bound to occur.

Involuntary job changes, however, are accompanied by serious losses to the individual and to his or her family. Some of these losses could be reduced if the person who has lost a job through no fault of his own could preserve some of the rights earned in the former job—seniority, pension, life and health insurance rights, for example.

Portability of such rights could be a legislative goal. Greater job relocation assistance would be another area for Government involvement. We suggest that the power of the two megatechnologies be put to work to give accurate, up-to-date information on jobs presently available and forecasts of future job requirements, in all parts of the country.

Financial aid, in the form of loans, mortgage guarantees, and similar support would ease the financial strains of relocation.

The second concept is that technology can be shaped to human needs. To do so requires an explicit understanding of those human needs when machines (and, therefore, jobs) are being designed. Problems with technology often arise because those most concerned with the human aspects of manufacturing—supervisors, human resource specialists, and workers themselves—are excluded from participating in the technological decisions made by engineers and designers.

This is an area for industry, labor and academic cooperation. Engineers need training in job design; human resource people need training in technology. Both types of people need to work together with labor to produce jobs that have meaning, challenge and opportunity. Industrial management needs to provide policy guidance to see that this happens.

In my statement I give five reasons for speeding the advance of these new technologies. Four of these are opportunities that are reasonably self-explanatory.

They are: (1) business growth through new products, (2) more competitiveness in existing American products, (3) improvements in quality of working life and (4) general improvements in our standard of living.

A fifth reason deserves study because it has some interesting possibilities. As the degree of automation increases, the fraction of the price of a product attributable to labor decreases. If that labor fraction becomes very small, then the low wage advantage held by a number of foreign countries disappears. Comparative advantage then shifts to the producer in the country where markets are near, materials and energy are less expensive, product designs and quality are superior, and service is available.

Many of these advantages reside in the United States. Adoption of intensive industrial automation then may uncover opportunities for traditional industries to repatriate work now being performed overseas.

Let me turn briefly to my second subject, remanufacturing.

As far as I have been able to determine, our studies at the Center for Policy Alternatives at MIT constitute the only systematic research on remanufacturing ever conducted in this country. It is a fascinating subject.

Remanufacturing is the process of restoring wornout or discarded products to their original condition. It involves the collection of "cores," as the non-functioning products are called, completely disassembling them, cleaning and refurbishing all usable parts, replacing parts that cannot be reused, and reassembling the product.

The remanufactured product may conform to original equipment specifications or it may be upgraded to perform like newer models of the same product.

It is likely to have the same warranty as a new product, and it is likely to have at least as high reliability and durability. Prices range from 40 percent to 70 percent of comparable new products.

My written statement includes a number of important social benefits from remanufacturing, including its contribution to energy and materials conservation, its savings to users and its profitability to producers.

The three characteristics I would like to stress here, however, are (1) The opportunities for employment afforded by remanufacturing, (2) the possibility of using remanufacturing approaches to upgrade, rather than scrap, older manufacturing technology, and (3) the possibility of selling remanufactured American products abroad.

Remanufacturing is labor-intensive. Much of the labor required is at fairly low skill levels. It provides good opportunities for entry-level jobs through which industrial experience and training can be obtained.

Remanufacturing activities are also quite portable. They can be situated in any location that is convenient to a supply of cores and labor.

Capital equipment requirements are low relative to original equipment manufacture. All these considerations suggest that remanufacturing should be encouraged in areas of high unemployment and economic distress.

There are highly successful remanufacturers that take conventional industrial machinery and convert it to computer-controlled, modern machines. It may just be possible that our enormous legacy of older machines in this country is not so much a barrier to reindustrialization as it is a resource, a resource that takes imagination and initiative to use. This is not suggested as any panacea, but companies that are hard pressed to upgrade their equipment and conserve scarce capital might look into what they can do with what they have.

In a similar vein, developing countries also find it hard to fund capital equipment acquisitions. If there are machines in this country for which there is no further use, other countries might be willing to buy them as remanufactured, upgraded equipment at the attractive prices that can be offered.

In remanufacturing both for our own industrial revitalization and for export, jobs are created, wealth is preserved, and resources are conserved.

What can Government do to encourage remanufacturing?

Of prime importance is that Government policy does not inadvertently discourage it. There is no general industry representation for remanufacturing in Washington, so it may be difficult for Congress to hear when this particular ox gets gored.

Government support might include procurement of remanufactured goods by Federal and State agencies and assistance in setting standards for the industry to define product quality and producer responsibility.

Favorable tax policies and assistance in obtaining capital, in recruiting labor and setting up export relationships would be other forms of Government encouragement.

Remanufacturing jobs stay here in America, and our remanufacturers prosper. These two facts alone call for a sympathetic appreciation for this activity.

We have been actively seeking ways at MIT to encourage remanufacturing. We have held two national conferences; we have advised members of the industry, and we have investigated specific opportunities for new remanufacturing ventures.

I would be happy to answer questions on these activities or any other part of this testimony.

[The prepared testimony of Mr. Lund follows:]

Statement of Robert T. Lund, Assistant Director
Center for Policy Alternatives
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Before joint hearings of the House Committee on
Science and Technology,
Science, Research and Technology Subcommittee, and the
House Budget Committee, Task Force on Education and Employment
June 9, 1983

I. MANUFACTURING TECHNOLOGY AND HUMAN RESOURCE POLICY

America is heavily dependent on technology for its production of goods and services. We rely on machines and know-how to sustain the torrent of products from our factories. We count on technological innovation to provide new products and to improve our production systems. To construct a picture of the future of jobs in industry, then, we must first have a clear idea of where technology is going. During this next decade, changes in technology will have a profound effect on the nature of work and on the structure of the workplace. Strategic plans and policies regarding people and jobs will be useful only if they are made within the context of the new technologies.

Dr. John Hansen and I, both members of the Center for Policy Alternatives at M.I.T. have just concluded a study of (1) emerging manufacturing technologies that will be important during the next decade and (2) the issues that will be raised by these technologies. This is the first public disclosure of the results of that investigation. The study was performed under the sponsorship of fourteen major U.S. firms, all leaders in their industries. Eleven of the fourteen manufacturing firms, whose combined annual output was approximately $110 billion. Their interest in sponsoring the study was to learn how their human resources would be affected by new technologies.

The opinions expressed in this article are those of the author and do not necessarily represent those of the Massachusetts Institute of Technology or of any of the sponsors of the research reported herein.

A time horizon of ten years for the application of manufacturing technology is about as far as one can go in making a reasonably safe forecast. Anything having a major impact within that time span will already be known either in actual application or in development. Conversely, a time horizon of ten years for human resources policy setting and implementation is about as short a time interval as will permit adjustment of skills, jobs, attitudes and size of workforce to the new technologies.

I will first briefly summarize our findings relative to new technologies, then describe the major human resource issues we see resulting from the application of these technologies and finally suggest areas of strategic response to these issues, both for private and public policymakers.

Megatechnologies of the Next Decade

If we consider every different manufacturing process (such as laser cutting of microelectronic chips) as a specific technology, then there are thousands of technologies in use in manufacturing, and the job of locating the significant ones is immense. If we look, instead, at the basic principles or devices underlying the specific process (coherent light or the laser, for example), then we find there are only about a dozen relatively new techniques that are the basis for virtually all of the emerging manufacturing technologies. This short list includes acoustics, computers, electron beams and plasmas, holography, lasers, materials substitutions, pattern recognition, robots, superconductors, telecommunications, and a small group of technologies lumped under the heading of biotechnologies (enzymes, genetic manipulation, etc.).

Of these dozen or so technologies there are only two that will have truly enormous impact on industry during the next decade. These two -- computers and telecommunications -- will be so pervasive and have such profound consequences that they deserve the attention of all concerned with industrial policy.

Each of the other techniques we examined in our study had important applications in a few industries, but each was relatively inconsequential as compared to the very great impacts to be expected from computers and telecommunications. Indeed, in many cases the value of these other technologies was found to be highly dependent on either computer or communications technology, as in the case of computer support to electron beam, acoustics, pattern recognition, or superconductivity applications.

Biotechnologies appear to have potential for very great long-run influence, but that influence is seen to be more than a decade away. Until the mid 1990's the real sources of hope and concern will be found in the industrial applications of the two "megatechnologies," computers and communications. Let us examine the reasons for their importance. They are summed up in three words: integration, pervasiveness, and convergence.

Integration. Both technologies have the unusual capability of linking many separate functions and coordinating them in ways that are beyond human capability, in speed, volume, accuracy or endurance.

For many years mini- and microcomputers have managed individual machine operations. In some continuous process industries, such as chemical manufacturing or oil refining, computers have managed complete systems consisting of multiple operations. The past decade has demonstrated the capability of the computer to integrate a number of machine tools, transport devices (including robots) and inspection and test functions into flexible, efficient, manufacturing units. Such manufacturing systems are capable of producing a variety of finished parts or products in a small fraction (on the order of 1/100) of the time required by conventional technology. During the coming decade we will see this form of computer-based integration advancing rapidly in the batch production segments of the metalworking industry and we will see continued advances of computer applications in continuous process manufacturing such as steel, textiles, paper, glass, etc. and in high volume discrete product manufacture such as automobiles and appliances.

In similar fashion, communications technology is also becoming integrative, as is exemplified by the local area network concept, in which all information generated within a firm or plant is available for use by people, machines or computers quickly, inexpensively and accurately. These systems, using a coaxial cable or optical fiber bus, as its spinal cord, are analagous to the human nervous system, in that many different functions can be carried out simultaneously. In addition to the spread of these integrating communications networks, the trend is also to link these networks through microwave and fiber optic channels across the country and the world.

Pervasiveness. Most technologies tend to be limited to only a few industrial sectors. A solvent extraction process may be useful in the manufacture of only a few chemicals; an electron beam process may be used only to weld certain metal parts. The great difference between such typical manufacturing technologies and the megatechnologies is that the megatechnologies apply equally well across all industries. Furthermore, they can be applied to existing process equipment as well as to new forms of machinery such as robots. Microprocessor controls can be added to existing machines to upgrade their performance. New communications systems can link existing sources of intelligence as well as new forms of remote sensing or voice command systems.

Not only are these technologies spreading throughout all manufacturing, but their pervasiveness is felt within the firm from the factory floor to the boardroom. In a sense, the diffusion of these technologies is very similar to the introduction of electrical motors into manufacturing late in the nineteenth century.

Convergence. Perhaps the most significant fact relative to computer and telecommunications, the element that holds out the greatest economic promise for the future, is that these megatechnologies are converging. New products and processes are being created that combine the power of the computer and of modern communications technology. The results can be seen in telephones that look like television screens and act like computers. The myriad product innovations that will spring out of the union of these two technologies is impossible to forecast. The opportunities for production and sale of new industrial, commercial and consumer products provides a reassuring prospect in what could be a rather difficult period of economic adjustment.

At the same time, however, the application of these integrative, converging technologies in manufacturing will have serious consequences for the workforce. We will examine these next.

Expected Impact on the Workforce

If computer and communications technologies are to be dominant sources of technological change in the near future, what can we expect the consequences to be for those employed in manufacturing? Several of the more important issues are discussed here. Our forthcoming report[*] develops these ideas and others more thoroughly.

The word "expected" is critical to this discussion. Our projections are based on current industrial practices and policies. While there are exceptions among firms, there is a general tendency to treat human resources and technology as independent subjects that are handled by separate groups of specialists. Prevailing practices and policies reflect this dichotomy. The issues we describe will arise if this approach continues.

Industrial policies can be changed, however. The relationships between people and technology are not necessarily fixed. We frequently see technology being bent to the needs of peole. If organizations such as those that sponsored our research become active in meeting the new megatechnologies with fresh policies, the consequences could be substantially altered. I will discuss later what some of those new policies might be. First, let us examine the expected outcomes if there are no policy changes.

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[*] Hansen, John A. and Robert T. Lund, Connected Machines, Disconnected Jobs, to be published later this year.

Displacement. Industrial employment levels are dependent on many factors other than manufacturing technology. These factors include:

1. The extent of international competition for product markets.
2. The stability of national and international economic and political conditions.
3. Product innovation and diffusion that stimulates new demand.
4. Labor price differentials or other cost advantages that encourage the flight of jobs to other countries.
5. The extent to which employment is shared through shorter workweeks, early retirement or other approaches.

Because the factors such as these can mask the employment effects of technology, we have not attempted to forecast its influence on future employment levels. It seems evident, however, that employment cannot be sustained at past levels in many industrial sectors.

What we do know is there will be widespread displacement. People will be forced to move within the firm or between firms, from one job to another, from one skill to another, from one location to another, from one social group to another. This displacement is likely to be accompanied by at least temporary unemployment for some workers. The new computer-aided technologies in design, engineering and manufacturing are enormously productive. Computer integrated manufacturing systems reduce labor requirements by factors ranging from 3:1 to 20:1 or greater. This is one of the reasons for believing there will be shrinking workforces in certain sectors. The effects of these levels of productivity increase simply cannot be compensated by market growth of comparable magnitudes. White collar job holders will also experience displacement. Jobs that have consisted primarily of gathering or passing on information are likely to disappear as these functions are taken over by computer/communications systems. As is explained later under infrastructure changes, staff specialist jobs are also likely to shrink or disappear.

Skills Changes. The nature of jobs will change. Instead of a direct physical involvement with the product or with the machine producing the product, the worker becomes a monitor, a parts loader or unloader, a troubleshooter, or an overseer of a process in which computer intelligence directs machines through their paces. As has already occured in chemical manufacture and some parts of steel and papermaking,the worker may be removed to a control room, physically separated from the sight, sound, feel or smell of the process. He or she is required to judge whether the process is proceeding correctly by observing machine conditions reported by meters, digital readouts and cathode ray tube displays. The new skills required to perform this kind of work include:

1. Conceptual thinking -- ability to reason in abstract terms
2. Visualization -- ability to manipulate mental patterns
3. Understanding of manufacturing processes
4. Statistical inference
5. Verbal communication

In addition, a monitoring role demands a high level of attentiveness to the task. In at least one firm the criterion of "responsible behavior" was used in selecting operators for automated systems. These skills and attributes are substantially different from the strength and motor skills (agility, dexterity, hand-eye coordination) that are being eliminated. It remains to be seen whether training or retraining can accomplish the kinds of skills adjustments required, particularly for more senior workers.

The role of production supervisor will also require new skills. In addition to being able to understand and manage a sophisticated technology, the supervisor must be able to integrate information and make decisions on an array of topics. As individual workers come to control entire systems of machines, collegial relationships between supervisor and worker will be more appropriate than formal boss-subordinate roles. Changes of this kind involve not only aptitudes but also the basic personalities of supervisors and managers. Here, too, is a formidable challenge to training and organizational development experts.

Integration of the Infrastructure. Conventional manufacturing organizations have had complex infrastructures of specialist groups responsibile for such functions as Quality Control, Inventory Control,Production Scheduling, Dispatching, Expediting, Materials Handling, Maintenance, or Time Standards. Computer-integrated manufacturing systems are so tightly coupled in time that decisions regarding an aberration in the process (faulty material, a machine out of control, a change in a customer's order) cannot be handled through channels that take specialists hours or days to work out. A new kind of production manager is likely to emerge who will be able to make decisions in minutes and still consider all the factors previously handled by specialists. New combinations of computer and communications technologies will make it possible for one person to receive and to coordinate all of the necessary information quickly and easily. This "control room executive" must be able to deal with a broader range of issues, use a greater amount of information and operate in a shorter time horizon than the current functional manager. He or she will also be operating much more alone, because fewer specialists will be needed, and there will be less need for data gatherers and sifters.

Gaps in Skills Levels Progression. It has been traditional in American industry for workers entering at low-level unskilled jobs to work their way up through a succession of jobs to more highly skilled, better paying positions. This traditional progression may be blocked by the effects of computer-based automation. The jobs that are the chief targets for elimination through the application of computers to production processes are the moderately skilled machine operators, welders, inspectors, assemblers, painters, platers, etc. that constitute a large bulk of the mid-range blue collar jobs. Jobs at either the high or low end of the skills spectrum are less likely to disappear.

If the mid-range jobs disappear, it is clear that there will be gaps or bottlenecks in the normal promotion process from lower to higher skill jobs. The inability to progress through transitional promotions is likely to cause frustration, anger and resentment among workers.

We believe similar gaps may begin to show up between the first-level operating management that is making very short-term operating decisions and a top level management that handles strategic planning and decision-making. In this case, the gap will result from the thinning out of middle managers and staff specialists whose jobs have been either taken over by integrative computer/communications systems or eliminated because of reductions in the number of people requiring supervision.

Loss of Management Status. Even if a manager or supervisor becomes comfortable with the increased technical content of the job (and many will not), the shift from managing people to managing machines may be perceived as a loss of status. The importance of a managerial job is, at present, often gauged by the number of people under his or her jurisdiction. Until new standards replace present conventional thinking, managers may find the transition uncomfortable.

Organizational Restructuring. Three factors point to the need for significant restructuring of the organization of manufacturing firms: (1) the emergence of the control room executive who replaces the staff specialist, (2) more responsive and complete networks of information easily accessible company wide, and (3) greater facility in the use of computer/communications systems for analysis and planning by top levels in the firm's management. These factors point to a thinning of the ranks of middle managers and functional specialists. Responsibility for operating decisions will be increasingly delegated downward; strategic plans and decisions will become the province of top management.

The implication is an organizational shift in two directions, a "recentralization" of strategic decision-making at top levels and a significant increase in delegated authority to first-level management. There would be much less in the middle levels. One might visualize such an organization as having a wasp-waisted pyramid structure.

Resistance to Change. It becomes clear that every level of the firm will be impacted by the megatechnologies. For many, these impacts will have negative connotations with respect to employment, income, job location, skills, social relationships, status, opportunity for growth and job satisfaction. In the face of such adverse conditions, the tendency is for people to resist change. Resistance can take overt forms of refusal or retaliation, or it can become subtle interference with or undermining of the purposes of the change.

Suggested Action

If these are the issues that will be increasingly important during the coming decade, what needs to be done to make the transitions as beneficial as possible for Americans? I suggest that the actions undertaken by any sector of our society concerned with these problems -- government, industry, labor, universities -- should have the objective of developing an environment that:

1. Promotes the positive aspects of change for the individual and the organization.

2. Provides maximum personal security during periods of transition.

3. Creates increased teamwork among government, industry, labor and academic organizations in solving the human problems imposed by the megatechnologies.

Keeping in mind these objectives, we can suggest possible actions to deal with some of the issues. These are summarized only briefly. They obviously require much more detailed development.

Displacement: Our first priority is to recognize displacement as a national problem. It has been largely hidden by the recession. Both public and private policy makers must realize that failure to deal with the problems of displacement will mean high and protracted unemployment levels. Specific policy recommendations for dealing with displacement include:

1. Increased corporate responsibility for continuity of employment of the individual, although not necessarily with the same firm.

2. National laws requiring portability of pension, seniority and group insurance rights.

3. Improved training and retraining resources more closely coupled to future industrial needs.

4. National and regional employment networks using the computer/communications technologies now available.

5. Closer cooperation among industrial firms, community service organizations (including schools), and labor organizations in the areas of job counselling, relocation assistance, and employment experiments.

Plant Conversion Dislocation: This is a subsidiary issue to the displacement problem. If companies are to rejuvenate their facilities in order to provide continuing employment opportunities in a specific community, there may be extensive temporary lay-offs during the renovation process. The objective during this time would be to maintain incomes while preparing the work force to handle new jobs competently. One policy suggestion is the establishment of local or regional cooperative assistance programs that would provide (1) temporary employment during the transition, and (2) training in new skills.

Job Progression Gaps: Here, too, recognition that there is a problem is the first prerequisite. Second is an awareness that technology is not immutable, that it can be tailored to fit human needs, and that people need not be forced to adapt to technology. Given these conditions the following policies are recommended:

1. Greater technical literacy among human resource and organizational development people in industrial firms, and management recognition that human resource people must participate in technology planning.

2. Increased emphasis on job design, in which technology is purposefully arranged to provide humans with both meaningful work and opportunity for advancement.

3. Redefinition of job evaluation criteria to conform to the new skills requirements of technologically-impacted jobs.

Organizational Restructuring: There is opportunity in this area for academic support to industry in providing people with the new managerial and technical competencies demanded. This involves the revamping of curricula to include subjects on manufacturing technology, job design, quality systems, and integrative manufacturing problem solving. Curtailment of professional jobs because of shrinkage of middle management and of manufacturing infrastructure will place additional demands on educational institutions for retraining of executives and staff people for new careers, and for job placement activity.

Exploitation of Opportunities: All these efforts would be of little purpose if there were no benefits to be gained from solving the problems. The benefits of these megatechnologies, however, are substantial, and crucially important to our economic welfare. We see five major areas of opportunity:

1. Prevention of further deterioration of our industrial competetiveness in international markets.

2. Industrial growth through products that exploit the new technologies.

3. Repatriation of product manufacture to America where the reduced labor content in the product makes labor cost differentials unimportant and thereby eliminates the comparative advantage of foreign countries.

4. Improvement in the quality of worklife, including the elimination of hazardous or demeaning work.

5. A higher general standard of living.

These opportunities are worth a concerted effort by all sectors of our society. Government must play an active role in removing barriers, to technological change, providing general economic stability, deciding problems of equity, and, on occasion, being the early buyer. Although the roles for government may be difficult and controversial, failure to provide the environment in which these opportunities can be grasped will put government policymakers in the even more difficult role of having to devise equitable sharing of a declining amount of work and income among its citizens.

II. REMANUFACTURING

Remanufacturing is a widespread but little recognized industrial activity in the United States. It has the unique capability of prolonging the lives of durable goods well beyond their normal economic lifetimes. In so doing, remanufacturing is able to conserve materials and energy, provide employment, improve our standard of living, reduce waste, and yield profits for those operating these businesses. For a variety of reasons remanufacturing deserves to be considered a weapon to combat the effects of recession and a part of our future way of life.

Remanufacturing involves collecting worn-out or discarded products of the same kind, disassembling them under factory conditions, refurbishing all reuseable parts, replacing unrepairable parts, and reassembling the parts into products having at least the equivalent performance of the products when new. In some cases, the products are upgraded in the process by substituting parts less likely to fail or by introducing new controls or other features made possible by newer technology. Such products carry a warranty comparable to that of a new product and are as reliable and durable as the original product. The price of a remanufactured product is typically between 40% and 70% of a new item.

The remanufactured products most familiar to the average American citizen are replacement automotive components, such as starter motors, alternators, clutch assemblies, water pumps or engines. Many other products, however, are also remanufactured. The list includes telephone headsets, computers, machine tools, pumps, valves, robots and even diesel locomotives. The military services also have remanufacturing facilities where equipment such as tanks and helicopters are restored to first-class condition.

In studies of remanufacturing conducted at the M.I.T. Center for Policy Alternatives we have found there were fairly well-defined criteria for what can be profitably remanufactured. From a physical standpoint the product must be durable, that is, it is not dissipated during use. It must be capable of disassembly, and a majority of its component parts must be repairable. From an economic point of view, the product should have a high value added. In other words, the labor, energy and capital equipment cost embodied in the product should be a high percentage of the product price. The non-functioning or worn-out unit (called a "core" in the trade) should have a low market or trade-in price as compared to its real economic worth. There must be a continuing supply of cores of reasonable quality.

The market for remanufactured products should consist of knowledgeable buyers who can evaluate the product and appreciate its worth. This criterion tends to restrict remanufacturing to commercial and industrial items, because most consumers at present are incapable of judging intrinsic product worth or are biased against used or older products. As remanufacturing becomes more prevalent, this restriction may change.

We have identified an impressive list of benefits to society provided by remanufacturers. Several of these benefits are especially pertinent to the search for new ways to solve the country's economic problems. I will describe those benefits briefly and then suggest ways in which remanufacturing could be put to work to assist the economy.

Resource Conservation

An outstanding contribution of remanufacturing is its conservation of energy and materials. Remanufacturing is one of those rare instances of an industrial activity whose products embody more energy than is used by the activity to produce them. Our studies indicate that for every kilowatt hour of energy used in remanufacturing from five to six kilowatt hours of equivalent energy are recaptured in the salvaged products. In a sense, remanufacturing can almost be said to be creating energy.

Materials conservation figures are even more impressive. For every pound of new material required to replace parts that cannot be reused, approximately eight pounds of valuable metals, plastics and other materials are conserved. Conservation of materials in the form of useable parts is a much more economic approach than is the recovery of materials through recycling processes where the only value saved is the raw material itself.

Favorable Pricing

Because prices can be significantly lower for remanufactured products than for new products, such items become attractive alternatives to users who must husband their cash. By offering lower priced options, remanufacturers broaden the market. They provide goods that can compete favorably with lower-priced foreign-made products, and they provide a stimulus to competitive pricing in markets that may be dominated by a few firms.

Employment Opportunities

Remanufacturing is a labor-intensive, portable industry. It can be located anywhere that is convenient for the collection of cores. Capital equipment investment is low relative to that of the original manufacturing process, and the labor skills required include a good many jobs at low levels. Remanufacturing thus is a prime candidate for introduction into areas of high unemployment and economic distress.

Profitable Business

Despite the low prices for their products, remanufacturers are profitable businesses. Increasing numbers of original equipment manufacturers are turning to remanufacturing their own products as a means of adding to their revenues. In recent years, some of these firms have found remanufacturing to be a major (even sole) source of profits. Remanufacturing is not only a source of employment and resource conservation, it is also a source of tax revenue.

Policy Suggestions Relative to Economic Recovery

This enumeration of benefits makes it fairly evident how remanufacturing can help American economic recovery. As a matter of fact, it is clear that remanufacturing is already making a substantial contribution, and one of the most sensible public policies would be to avoid doing anything that would interfere with its growth and development.

There are some special possibilities, however, that should be considered:

1. Remanufacturing can be used to upgrade existing manufacturing and service technology. Many older machines can not only be restored to like-new performance but they can be upgraded by the addition of electronic sensors and controls to match the sophistication of new machines. Remanufacturing can make an important contribution to re-industrialization.
2. Areas especially hard hit by plant closings should consider using the abandoned plants and workforces as bases for remanufacturing. In some instances, the product remanufactured might even be the product originally produced in that plant.
3. Remanufactured items produced by reputable American firms may find acceptance in other countries. This would be especially true for industrial machinery, transport vehicles and replacement components. Many countries have had bad experience with used equipment "deals" from the United States, so they are wary of buying items that are not new. Warranted goods from an established remanufacturer could have a better reception, however.

Public Involvement

There is one strong factor in favor of remanufacturing: its jobs do not move overseas. Remanufacturing is very much an American form of enterprise. It is a highly beneficial activity that should be encouraged.

What can the government do relative to remanufacturing? It can act as a source or a catalyst for standards for the industry, so a remanufactured item is recognized as conforming to certain quality and performance requirements. It can act to advocate the purchase of remanufactured goods through example, using the purchasing policies of government agencies to demonstrate support. Finally, it can act to encourage the establishment and growth of remanufacturing activities by favorable tax, capital assistance, employment and export policies.

Because of the diversity of their products, remanufacturers are not represented as an industry in Washington. Few congressmen have ever heard of the activity. There is a need for advocacy, both in the industry and in the government. It is expected that a clearer recognition of the advantages of remanufacturing will stimulate action on its behalf.

Mr. GEPHARDT [presiding]. Thank you very much.

Our next speaker is Dr. Joel Hirschhorn. Welcome.

[The biographical sketch of Dr. Hirschhorn follows:]

BIOGRAPHICAL SKETCH OF DR. JOEL S. HIRSCHHORN

Dr. Hirschhorn is a Senior Associate at the Office of Technology Assessment, the analytical arm of the U.S. Congress whose basic function is to help legislators anticipate and plan for the positive and negative impacts of technological changes. During the five years he has been at OTA he has directed two major assessments. His project on the management of hazardous wastes has received widespread attention and has influenced a number of legislative efforts to modify and improve the Federal regulatory programs under the Resource Conservation and Recovery Act, and Superfund. His work on the international competitiveness of the U.S. steel industry is generally regarded as the premier government analysis of the problems facing this industry. It was this study that brought national attention to the restructuring of the domestic steel industry and the rise of the scrap-based "minimills". Dr. Hirschhorn has testified on behalf of OTA at a great many Senate and House hearings, is called upon frequently to speak at conferences and seminars, and has published extensively on his policy studies.

Prior to joining OTA, Dr. Hirschhorn was a full professor of engineering at the University of Wisconsin, Madison where he concentrated his teaching and research on manufacturing processes, and introduced programs on the impact of technology on society. His textbook on powder metallurgy has been used worldwide for many years, and he received a number of teaching and research awards. He also served as Director of Research for a small manufacturing company, was a management consultant to many U.S. and foreign firms, and was a research metallurgist for Pratt & Whitney Aircraft.

His Ph.D. was earned in Materials Engineering at the Rensselaer Polytechnic Institute, and his B.Met.E. and M.S. (Met.E.) were earned at the Polytechnic Institute of Brooklyn. He has written several books, over 100 professional articles, and has two patents.

Dr. **HIRSCHHORN**. Thank you, Mr. Chairman.

I will sumamrize my formal statement.

In 1980 we delivered to the Congress a report on the steel industry. We have continued to examine the problems facing the steel industry. I will concentrate today, of course, on the problems concerning employment in the steel industry.

First, I give some data to point out that during the last 30 years there has been a tremendous decrease in employment in the U.S. steel industry.

In 1953 there was close to 700,000 workers in the U.S. steel industry. In March of this year there were only 240,000 workers in the steel industry.

The nearly two-thirds drop in employment in the last three decades is not matched by a corresponding drop in capacity to make steel. There has been a steady improvement and change in technology that is used by the U.S. steel industry.

In fact there probably has been a profound change in technology. This has led to the reduction in employment.

I won't go into all the details of exactly what these technological changes are, but they have been many and they have had a major impact on employment as well as a number of other areas.

Competition from foreign steelmakers during the last few decades, as well as competition from domestic minimills, a different approach to making steel, has placed considerable pressure on the management of large, integrated steel-making companies to reduce costs.

One way that they have done this is to seek ways to use less labor to make steel.

I might note that the minimills, which are not so familiar to people, are smallish type of companies. There are 50 to 60 minimills in the United States. They are based on using scrap, ferrous scrap, whereas the large integrated companies that most people associate with the steel company are primarily based on using iron ore and coke, virgin raw materials, to make steel.

I want to emphasize that the trend, the marked decline in employment that we see for the last several decades in the steel industry is indeed a long-term trend. It is not linked uniquely to the latest economic recession. It has been going on for some time. It would be wrong to believe that general economic recovery, which will bring increases in domestic steel production, will also lead to a dramatic improvement in employment.

If anything, steel industry management has used the severe downturn in production during the past few years to further reduce labor intensity permanently.

There will likely be further closings of some integrated plants because they are technologically obsolete, poorly located with respect to markets and raw materials, and represent unattractive investments for modernization.

I think it is difficult to predict exactly what this further shrinkage in integrated steelmaking will be, but I think a reasonable estimate for the rest of the decade is that we will probably see a 10- to 20-percent reduction in the existing integrated steelmaking capacity.

This reduction in steelmaking capacity in the larger integrated companies will be offset to some degree by the continued expansion of the minimill segment of the industry.

Depending on technology developments, minimills may be able to approach a level of 30 to 40 percent of domestic production by the end of the decade.

I might note that even during this past recession minimills have been expanding, and although they have been hurt by the recession, they have not been hurt nearly as much as the integrated companies.

Let me summarize then a series of factors for explaining the sum effect for employment in the domestic steel industry.

For the remainder of this decade, there will be some slight improvements in employment due to recovery and greater levels of production. But these employment increases will likely be offset by a number of factors.

First, there will be continuing technological improvements within the integrated plants themselves which will reduce labor intensity. There will be a continuing shift of production from integrated companies to minimill plants with a net reduction in workers.

There will be, probably, closure and merger of some integrated companies with a net reduction in workers. Possibly there will be greater imports of steel slabs, of finished steel products, and of manufactured products which are steel intensive. Last, there will probably be continued erosion of steel markets due to greater use of alternative engineering materials, things like plastics, aluminum, and others.

It would be inappropriate, therefore, to conclude or believe that employment in our steel industry will ever again return to high levels.

The remainder of the decade will probably see further losses in jobs with total employment approaching the 200,000 level by 1990.

I would like to just shift a little bit now. This is sort of the direct picture of the employment situation, and talk a little bit about technology and labor and the work place.

As we indicated in our 1980 report, although the steel industry generally is thought of as a mature industry, technology has been changing dramatically and it will probably continue to do so, but I also have to point out that in most of the technological areas the domestic steel industry has not kept pace with major technological changes being adopted more substantially in foreign steel industries.

I won't go through all the details in the formal statement, but I would note, for example, that probably the most important technological change is continuous casting of steel; and in this area our integrated companies now make about 15 percent of their steel with continuous casting compared to over 70 percent for Japanese integrated companies.

Most of the foreign steel industries that compete with us have much more extensive use of continuous casting. Continuous casting is really a profound change in the way steel is made. It leads to advantages in almost all areas, but it also improves efficiency and reduces employment.

We will see in the United States during the next decade continued adoption of more continuous casting to catch up with foreign competition. This is yet another factor that will lead to some loss of jobs. We still make some steel in the United States by the antiquated open hearth process. This will probably be phased out in the next few years.

That too will lead to a loss of jobs.

We have seen in our industry, as well as foreign steel industries, adoption of automation, sophisticated electronic controls, and remote sensing devices, more so in foreign steel industries than domestically, but our steel industry will have to catch up in this area too, and the adoption of, so to speak, high tech products—computers, et ceteria—will also lead to loss of jobs.

There is perhaps a profound change on the ironmaking side of the business, the front end of steelmaking, called direct reduction. Around the world direct reduction is replacing, has replaced blast furnaces and it is possible within about 5 to 15 years we will see some major technological changes that will replace blast furnaces in the United States.

This new technology will also have the effect of having greater efficiency and reducing labor intensity.

I might also note that the minimill phenomenon will continue and there are new technological developments we expect to see in minimills generally leading to the ability of the minimills to make more sophisticated products and eventually even make flat products which are now made only by integated companies in the United States.

We, therefore, expect general markets to be captured by minimills, taken away from the integrated companies with a net loss of jobs in integrated companies. The alloy specialty segment of the industry is relatively small, but it is technologically superior to its world competition. It is very cost competitive. It is very R&D intensive.

Unfortunately, it has seen some tremendous inroads in markets by imports in the last few years, but if that situation is resolved there may be some continued expansion of the alloy specialty segment, but the number of jobs that would be created would be extremely small relative to the loss of jobs in the integrated segment.

So, in summary, we expect to see continued technological changes, even in the integrated steelmaking segment of the industry, and eventually we will see develop a much more modern domestic steel industry, but, of course, it will be a much smaller steel industry.

Lastly, let me say the workplace is changing in steel making. Generally we have always thought about steelmaking and the environment the people have to work in as consisting of severe physical demands on workers as well as unattractive heat, noise, fumes. All of this will change.

Steelmaking plants will become more modern, high tech type of manufacturing operations. The work place will be more technologically sophisticated and automated, cleaner, and the required skills for workers will be more intellectual than physical.

They will have to have more technical skills; they will work with electronic controls, computers, and information rather than with direct physically demanding contact with very hot and dangerous materials.

To sum up then, the U.S. steel work place of the future can actually be seen today in foreign steel industries, but the price for achieving that more attractive work place here will be fewer jobs.

Thank you.

Mr. GEPHARDT. Thank you very much.

[The prepared statement of Dr. Hirschhorn follows:]

STATEMENT OF JOEL S. HIRSCHHORN
PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
COMMITTEE ON SCIENCE AND TECHNOLOGY
AND THE
TASK FORCE ON EDUCATION AND EMPLOYMENT
COMMITTEE ON THE BUDGET
UNITED STATES HOUSE OF REPRESENTATIVES

June 9, 1983

Mr. Chairman and Congressmen, my statement makes use of the findings of OTA's report to Congress on TECHNOLOGY AND STEEL INDUSTRY COMPETITIVENESS, released in 1980, and subsequent examinations of the status of the domestic steel industry. At your request, today I will focus on the impact of technology on the work force and workplace in the United States steel industry. First, I will summarize the past trends in employment in the industry and provide a picture of likely future changes in employment based on our understanding of changes in technology, structure of the industry, and market conditions. Second, I will summarize the most important technological changes which have already occurred and those likely to occur during the next decade, including their likely adoption by our steel industry and their impact on the steel industry workplace.

TRENDS IN EMPLOYMENT IN THE U.S. STEEL INDUSTRY

Examining government statistics on employment in the domestic steel industry for the last thirty years reveals the substantial decline that has taken place:

Year	Total Employment
1953	682,000
1960	587,000
1970	553,000
1980	420,000
1982	304,000
1983 (March)	242,000

While the capacity of the industry for shipping finished steel products has diminished somewhat over this same period, it does not compare to the nearly two-thirds drop in employment. A fundamental factor in accounting for this employment drop is that the technology of steelmaking has changed profoundly over this period, and the labor intensity of the industry has decreased markedly. Major technological changes include the use of basic oxygen furnaces to replace open-hearth furnaces, ferrous scrap based electric furnaces to replace basic oxygen furnaces and the use of blast furnaces, continuous casters to replace ingot casting and reheating furnaces, and substantial automation throughout iron and steelmaking processes.

Competition from foreign steelmakers as well as from domestic minimills (based on using scrap) has placed considerable pressure on the management of our integrated steelmaking companies (based primarily on using iron ore) to reduce costs. A major way to reduce production costs has been to make steel with less labor. But even today labor costs per ton of shipped steel are very high for our steel industry versus some foreign competitors, as wages have risen faster than labor productivity improvements.

It should be emphasized that the marked decline in employment has been a long-term trend and is not linked uniquely to the latest economic recession.

In this regard, it would be wrong to believe that general economic recovery which will bring increases in domestic steel production will also lead to a dramatic improvement in employment. If anything, steel industry managers have used the severe downturn in production during the past few years to further reduce labor intensity permanently.

Moreover, much of the steelmaking capacity closed down in recent times will remain closed. Indeed, it is likely that for the remainder of the 1980's there will be further closings of some integrated plants because they are technologically obsolete, poorly located with respect to markets and raw materials, and represent unattractive investments for modernization. What this future additional decline in domestic integrated steelmaking capacity will be is uncertain, but it is likely to be in the 10 to 20 percent range of existing integrated steelmaking capacity.

This reduction will be offset to some degree by the continued expansion of the minimill segment of our industry. In our 1980 report we forecast that with present technology by the end of the decade minimills could account for about 25 percent of domestic steel production. They are close to meeting that capability today with about 20 million tons of steelmaking capacity now in place. However, labor productivity is substantially higher in minimills than in integrated plants, and far fewer workers will be required to support continued expansion of perhaps another 5 million tons in coming years. Depending on technology developments, minimills may be able to approach a level of 30 to 40 percent of domestic production by the end of the decade. Furthermore, as we have already seen during the past decade, the opportunities presented by the successful minimills are in different geographical locations than the older integrated plants.

Thus, in summary, for the remainder of this decade there may be some slight improvements in employment due to recovery and greater levels of production. But these employment increases will likely be offset by

o continuing technological improvements in integrated plants which reduce labor intensity, o continuing shift of production from integrated to minimill plants with a net reduction in workers,

o the possible closure and merger of integrated companies with a net reduction in workers,

o possibly greater imports of steel slabs which would cause the closing of the front, ironmaking end of some integrated plants, greater imports of finished steel products, and greater imports of manufactured products which are steel intensive,

o some continued erosion of steel markets, due to greater use of alternative engineering materials, which contributes to keeping any long-term growth for the industry quite low.

It would be inappropriate, therefore, to believe that employment in our steel industry will ever again return to high values. For the remainder of the decade there may well be some further losses in jobs with total employment approaching the 200,000 level by 1990.

TECHNOLOGY AND LABOR

As noted in our 1980 report, although the steel industry is generally thought of as a "mature" industry, technology has been changing dramatically. In most technological areas, however, the domestic steel industry has not kept pace with major technological changes being adopted more substantially by foreign steelmakers.

One exception is the use of electric furnaces based on scrap rather than iron ore, primarily in our minimills. About 30 percent of domestic steel is now made in electric furnaces, one of the highest fractions among world steel industries. The U.S. has the world's largest supply of ferrous scrap, and we are likely to see further expansion of electric furnace use that implies lower labor intensity. This trend is particularly significant for the domestic iron ore industry.

However, in several other areas the domestic integrated producers have fallen behind in the adoption of new technologies that increase labor productivity. A major example is the use of continuous casting. Our integrated producers make about 15 percent of their steel with continuous casting, compared to over 70 percent for Japanese integrated producers and similarly greater levels in other foreign steel industries. Although domestic integrated producers are now attempting to install more continuous casters, based primarily on technological improvements made in foreign steel industries, it will likely be another decade before we catch up with our foreign competition. The management of domestic integrated steelmakers continue to face problems in making the large capital investments for continuous casters, and diversification out of steelmaking may continue. But as more continuous casting is used here, labor productivity will improve.

Unlike almost all other free-world steel industries, our steel industry continues to make some steel in open-hearth furnaces rather than in basic oxygen and electric furnaces. This is likely to change within the next few years and result in some loss of jobs.

In some foreign integrated steel industries, there has been more widespread use of automation, sophisticated electronic controls, and remote sensing devices which improve labor productivity, although here too we are making progress which will reduce employment gradually.

Much of the world steel industry has shifted from using blast furnaces (to convert iron ore to metallic iron with the use of coke) to various forms of direct reduction technology. Direct reduction techniques do not use coke; some use natural gas and others use cheaper grades of coal directly. There continues to be substantial foreign technological developments in direct reduction with considerable emphasis lately on techniques that can produce molten iron rather than solid direct reduced iron pellets.

Sometimes called direct smelting approaches, these new forms of direct reduction have the advantage of using low cost iron oxide raw materials rather than virgin iron ores, and they can be used in conjunction with existing basic oxygen steelmaking furnaces. They also can be built on a smaller scale economically as compared to the large economy of scale blast furnaces. One of the important things that the minimill development has demonstrated is that it may make more sense to build smaller steelmaking plants rather than very large plants with high capital investments.

It is likely that within 5 to 15 years, some of these foreign direct reduction and smelting technologies will become adopted in the U.S. with some improvements in labor productivity. This is important because our integrated plants will, of course, continue to grow old and there will be opportunities for major new investments in integrated steelmaking at some time. While our minimills represent an important dimension to the restructuring of our industry, we will always need a large integrated steelmaking capability to produce a number of high volume steel products.

It should also be noted that minimills are aggressive in pursuing technological innovations, and there will be continued improvements in this sector. Many of these changes, such as ladle refining of steel, will assist the trend to making more sophisticated and higher quality products, with further erosion of markets now held by integrated companies. There is also increasing optimism about the prospects of making flat products on a smale scale economically with new types of rolling equipment. Furthermore, our technologically superior alloy/specialty steel companies, although now facing substantial loss of markets to foreign competition, are likely to maintain their high investments in R&D and new technology - unless market growth is absorbed by imports.

In summary, although there are significant uncertainties regarding investments in R&D and adoption of new technologies by integrated steelmakers, there will likely be a continued trend of technological change in our surviving and probably smaller steel industry. Much of the new technology and equipment will come from foreign sources. The trend of improving and changing technology is necessary to maintain competitiveness, improve profitability, and improve product quality and innovations. But another likely consequence is that labor productivity will gradually increase which will contribute to reduced employment. Another dimension to the continued changes in technology is that the workplace is also changing.

The traditional steel industry workplace consisting of severe physical demands on workers, as well as unattractive heat, noise, and fumes will become a more modern "high tech" type of manufacturing operation. The workplace will be more technologically sophisticated and automated, cleaner, and the required skills for workers will become more intellectual. Steel mill workers will require greater technical skills, and will work more with electronic controls, computers, and information rather than with direct, physically demanding contact with very hot and dangerous materials. This evolutionary change and increased worker requirements may eventually forestall major reductions in the wages of steel workers. The U.S. steel workplace of the future can be seen today in some foreign steel industries, but the price for achieving that more attractive workplace here will be fewer jobs.

Mr. **Gephardt**. Our last witness is Timothy Howard, Vice President, Chief Economist, Federal National Mortgage Association. Welcome.

[The biographical sketch of Mr. Howard Follows:]

BIOGRAPHICAL SKETCH: TIMOTHY HOWARD

Timothy Howard received his Bachelor's degree in economics from UCLA, Magna Cum Laude, in June 1969. He received his Master's in economics, also from UCLA, the following year. Upon leaving graduate school, Tim spent several years working abroad, including three years in Mexico City organizing an export manufacturing company. In 1975, Tim returned to the United States to join the financial forecasting group of Chase Econometric Associates, an economic and consulting subsidiary of the Chase Manhattan Bank. Subsequently, Tim spent six years in the economics department at Wells Fargo Bank in San Francisco, serving from 1978 as Wells Fargo's Vice President and Chief Financial Economist. Tim assumed his present position as Chief Economist of the Federal National Mortgage Association in March of 1982.

Mr. **Howard**. Thank you. It is a pleasure to be here today to participate in these hearings on the outlook for key industries and their potential for generating employment over the balance of the decade.

I intend to focus my attention on the housing sector specifically, both in the recent past and future, and I will address some of the issues that were contained in a recent report written for the task force entitled "The Engines of Postwar Economic Growth."

In that report it was argued that the housing sector is not likely to stimulate growth to the same extent in the 1980's as it did in the sixties and seventies.

I would be inclined to agree with that in general.

As I will discuss below, my own forecast for housing starts over the balance of the decade is that they will average somewhere around 1.7 million units.

That is a tad below where they were in the seventies, by about 60,000 to 65,000 per year. However, I would add that even at this level housing starts will be a key ingredient to economic activity, both from the standpoint that housing has always been an important objective for people to work toward, and as a key element in overall productivity and work effort. In terms of specific economics, demand for housing and the effect on employment, there are two primary ways we can look at the importance of housing.

The first one is fairly straightforward, simply as a percent of the gross national product. During the postwar period housing construction, as a percent of GNP, has averaged around 4¾ percent. It has been a little bit less the last 10 years due mainly to the poor environment of 1980, 1981, and 1982.

A different way to measure housing and its impact on employment, which may be more relevant in the context of these hearings, is to look at the impact of housing on related industries.

According to a study by the Bureau of Labor Statistics and the National Association of Homebuilders, building a thousand single-family units will result in the creation of roughly 1,750 jobs.

Two-thirds of those are off-site in industries supplying materials, equipment, or other goods.

One-third of that is directly related to construction of the unit itself. For multifamily construction, the numbers are a little lower. For 1,000 units, it results in 185 jobs, two-thirds offsite, one-third onsite. Neither of these figures includes two important side effects of housing activity. One of them is the expenditures in related industries—furniture, fixtures, appliances, and so forth.

The other is what economists term the multiplier effect, the fact somebody paid for building a home will in turn use that money to buy other goods and services, thereby generating additional demand.

I think the estimates on the impact of housing starts on employment that were generated over the last 10 years or so will be reasonably accurate for the next 10 years.

Certainly there are technological trends such as manufactured housing that may have a modest impact in reducing person hours per housing start, but then manufactured housing in particular will only impact that one-third of total activity that is directly on site.

Even there I think you are only talking about a 5-percent or so potential decline.

In looking for a determinant for total employment in housing, I think it is much more important to focus on the overall level of housing starts. Certainly the employment impacts of housing will be much different if you are running at 2 million units per year than if you are running at 1 million units per year.

For the balance of my testimony, I want to talk a little bit about what we see happening in housing in the future and why.

Let's review what has happened in the last 3 or 4 years.

As I don't have to tell this committee, housing has been in a virtual depression during that time. In retrospect, I think there were three reasons for it.

The first has to do with the effect of rising inflation on home ownership desires. As inflationary expectations mounted throughout the 1970's, people began to look at housing as an investment vehicle. The availability of low cost financing, interest rates that were really below the inflation rate even before taxes, and very much below it after taxes, encouraged people to borrow and go out and buy a home.

That is reflected in the price statistics.

The median price of a new single-family home rose by 175 percent between 1970 and 1980; whereas the general price index only rose by 95 percent. That made housing much less affordable for the average American.

A second factor which really was related to the first one was that, after several years of rising inflation, the monetary authorities finally responded to that. Interest rates rose dramatically in the late seventies and early 1980's. If you look at a traditional single-family mortgage rate, those averaged around 8¾ percent, a little under 9, between 1970 and 1978.

Between 1979 and 1982, they averaged 14.5 percent. The combination of higher prices and much higher financing costs meant that for a typical family to pay the interest on a typically priced house, the ratio of income necessary to do so rose from 17 percent in 1970 to 37 percent in 1981, late 1981.

That clearly priced most people out of the market. One additional element that really was related to the financing costs that also hit housing at the same time was the deregulation of the financial services industry. Traditionally, the system of regulated rate deposits at banks and savings and loans had been a very effective means of channeling low-cost credit into the housing market. That system worked as long as interest rates were low and the deposit ceilings remained in force.

As we moved into the late seventies, that system began to fall apart really for three reasons.

First of all, interest rates stayed high. Related to that, we had the growth of the money market mutual funds which took enormous amounts of money out of savings and loans and banks.

Finally, we began to realize that a system of holding short-term rates down in banks and S&L's really was penalizing savers and subsidizing borrowers.

The result of those three factors led to, through legislation, the deregulation of interest rates at banks and S&L's. That caused, first of all, interest rates to go up. Deposit costs went up, and in turn loan costs went up.

Just as importantly, it suddenly made the traditional business of borrowing short and lending long much riskier and much less reliable as a means of supporting housing finance.

As a result, we saw the problems with the S&L's and a lot of people getting out of the business.

Put those three things together and you end up with a housing industry that is flat on its back, as it was in 1980, 1981, and 1982.

As most of you, I am sure, have observed, things have changed dramatically in the last 6 months. Interest rates are down, housing prices have leveled off, and in addition to that the newly authorized money market deposit accounts have flooded the banks and S&L's with money.

Money is available again and reasonably affordable. As a result, housing has taken off. New home sales are up 70 percent from their lows of last April.

Existing home sales are up nearly 50 percent from their lows of last August. Housing starts are up 60 percent from their lows of last June. It is beginning to look like business as usual in the housing industry again.

Interest rates are down, mortgage lenders are making fixed rate loans, but it really isn't business as usual.

As I see it, there are three important obstacles to the continuation of a healthy housing market. The first one is the presence in David Stockman's terms literally as far as the eye can see of $200 billion budget deficits which ultimately will drive up interest rates for homebuyers if they are not reduced.

A second obstacle is the fact that by the very nature of their deposit liabilities, banks and thrifts will now be in a position to turn off the credit spigot as quickly as they turned it on if interest rates go back up again.

Finally, even if rates do stay down, thrift institutions, in particular, are likely to diversify out of mortgages into other assets to take advantage of their newly liberalized asset powers.

So what does all this mean for the housing outlook for the next 7 years or so?

On the demand side, conditions look relatively favorable. Certainly for the next 2 years we will have the effects of pent-up demand, those people who were shut out of the market when interest rates were at 17, 16, and 15 and are now back in the market. They are buying homes. That, in turn, is encouraging construction of homes.

For 1983 and 1984, the factors look fairly good. Beyond that, looking at some of the demographics, it is a little less positive, but on balance I think it is reasonably strong.

On the one hand, we are projecting a relative slowdown in the growth of the adult population. The fact that the divorce rate seems to be lessening means that you are getting relatively fewer households formed. That too would be a relative drag on the demand for housing over that period.

On the other hand, we have a larger percentage of the homebuying public moving into income and age brackets where people typically do buy homes.

Putting those all together, we end up with an estimate that housing starts ought to average around 1.7 million over the balance of the decade. If that is right, and using the relationships I discussed earlier between housing starts and employment, we figure that 1.7 million units should result in about 2.5 million jobs created directly in construction, and construction-related industries.

Additional jobs—although it is hard to quantify—should be created in those sectors complementary to housing, like furniture and appliances, and through the so-called multiplier effect.

In terms of total impact on GNP, we are estimating the direct and induced expenditures related to the residential construction we foresee which will amount to about $225 billion per year on the average, expressed in today's dollars.

That would be about 6¾ percent of GNP.

I would like to reemphasize, though, that this level of housing starts—the 1.7 million units—will be very difficult to attain if financing does not remain available and affordable.

In that regard, it is critically important to the housing industry that first of all we reduce the $200 billion budget deficits to give that sector room to breathe financially.

It is a large user of credit.

Second, we also need to help the mortgage finance industry, both the primary and secondary market, to devise new institutional and regulatory frameworks to operate efficiently in a deregulated environment.

This involves things like new products, procedures, laws and regulations. If we can do those two things, then I am confident that housing can and will hold its own as a strong force for economic growth in the 1980's with all of the positive benefits that has on production and employment.

I, as well as my fellow panelists, will be happy to answer any questions you may have on these subjects.

Mr. GEPHARDT. Thank you very much.

[The prepared statement of Mr. Howard follows:]

Statement by

Timothy Howard

Vice President and Chief Economist
of the
Federal National Mortgage Association

before the

Subcommittee on Science, Research, and Technology
and the
Budget Committee Task Force on Education and Employment

United States House of Representatives

June 9, 1983

Mr. Chairman, my name is Timothy Howard. I am the chief economist of the Federal National Mortgage Association.

It is indeed a pleasure to participate today in these hearings on the outlook for key industries in the United States and their potential for generating employment opportunities in the 1980s. I shall be focusing my attention on the importance of the housing sector, both in the recent past and in the future. In my remarks, I will address some of the issues raised in a report recently prepared for the Bipartisan Congressional Task Force, entitled "The Engines of Postwar Economic Growth." Essentially, this report argues that housing activity will not stimulate growth in the 1980s the way it did earlier in the postwar period.

I would not be inclined to challenge that assertion, at least as far as it goes. As I discuss more fully below, my own expectation is that housing starts will run about 1.7 million units per year over the balance of the decade. This rate of production is slightly less than the average of the 1970s.

I would hasten to add, however, that the housing sector will continue to be a key ingredient in any economic expansion, for many of the same reasons that it has in the past. From a social standpoint, homeownership has always been a central goal for the vast majority of American families, one towards which they have channeled a considerable portion of their productive effort.

While achievement of this goal has been frustrated in recent years, I see no compelling evidence that it has become any less important. The basic demand for housing thus should continue to be governed by demographic forces, and these are by and large favorable.

From an economic point of view, the housing industry ranks as one of the most critical sectors of the economy. Throughout the postwar period, it has been at the cutting edge of economic recoveries, typically leading upturns in aggregate production by several months. Its importance can be measured in several ways. As a percentage of gross national product, residential investment has absorbed about 4 3/4 percent of total expenditures on average over the postwar period, a figure that seems small until you realize that this is about equivalent to the largest postwar peak-to-trough decline in output. An alternative measure, of perhaps more interest in the context of these hearings, is the tendency for housing activity to generate demand, and thus employment, in related industries. According to research conducted by the Bureau of Labor Statistics and the National Association of Home Builders -- based on input-output tables for the U.S. economy -- the construction of 1,000 single-family houses creates about 1,760 jobs, two-thirds of which are off-site in industries supplying materials, equipment, and other goods and services used directly in the construction of these units. The corresponding number for 1,000 multifamily units is about 825 jobs, again split in roughly a two to one ratio. Neither of these figures includes the employment generated by the spending and respending of the wages paid to these workers via the familiar multiplier -- or so-called "rippling" -- effect, or the impact of induced spending on other goods and services that are complementary to housing, such as home furnishings, appliances, utility hook-ups, and so forth. These latter two effects fall outside the 4 3/4 percent of GNP represented by residential investment and thus should be added when assessing the overall impact of housing on employment and economic activity.

To assess properly the outlook for housing, we need to step back and see where this industry has been and what has brought it to where it is today. In recent years, of course, residential construction has suffered an extremely severe slump, caused by the confluence of three unfavorable factors. The first of these was the inflationary environment of the 1970s. Expectations of continually rising prices stimulated widespread investment demand for housing as an inflation hedge -- a demand that was fueled by the availability of large volumes of mortgage credit at negative real after-tax interest rates. This in turn pushed prices of houses up rapidly relative to other goods. Between 1970 and 1980, the median price of a new house rose 175 percent in comparison to a 95 percent increase in the overall price level, as measured by the GNP deflator. In many regions, restrictive zoning and other regulations -- adopted in part to enhance the values of existing structures -- placed severe limits on new construction, further exacerbating the housing price increases in those areas.

The second factor behind the housing slump was the substantial increase in interest rates that occurred in the late 1970s and early 1980s as inflationary expectations became more deeply entrenched and monetary policy was tightened to bring inflation under control. These rate increases compounded the effects of increases in the relative price of housing on monthly carrying costs, and effectively shut a large percentage of the population out of the housing market because they could not afford the monthly payments on homes of even modest size. During the 1970s, the percentage of median family income required to service a loan on a median-priced house -- one measure of "affordability" -- rose from about 17 percent to nearly 30 percent. Barely two years later, at the end of 1981, it stood at almost 37 percent.

The third factor holding down housing activity was the deregulation of depository institutions. Under the shelter of deposit insurance, regulated interest rates, and preferential tax treatment for mortgage lending institutions, the thrift and banking industries had developed over the years into a low-cost and by most criteria very efficient mortgage delivery system. However, the viability of this system depended on regulated interest rates and a stable, upward-sloping yield curve that allowed these institutions to attract and retain low-cost deposits to lend long-term at a profit. For several decades those conditions prevailed, although in the late 1960s and early 1970s periodic increases in market rates above deposit rate ceilings substantially reduced deposit flows, and temporarily curtailed credit availability in mortgage markets. Still, even this situation was tolerable so long as these periods of disintermediation were brief. Yet by the late 1970s the system was beginning to show evident signs of strain. Sustained high interest rates, the explosive growth in money market mutual funds, and a growing realization that a system of regulated deposit ceilings unfairly penalized savers and subsidized borrowers all combined to result through legislation in the rapid phase-out of deposit ceilings. This deposit deregulation raised the cost of mortgage money still further. Even more importantly, by making the cost of hundreds of billion dollars in bank and thrift deposits subject to the vagaries of the money market, it meant that the traditional "borrow short-lend long" activities of depository institutions had become a riskier and much less reliable means of channeling funds to homebuyers.

The net result of all this was, as I have already noted, a severe and prolonged depression in housing activity that occurred in spite of the fact that demographic factors were really quite favorable. Many households who normally would have purchased homes in the last few years simply had to defer these transactions until costs and incomes came into better balance.

Recently, as all of us know, interest rates have come down substantially, home prices have been virtually flat for a year or so, and depository institutions have experienced massive inflows into their newly-authorized money market deposit accounts and are back in the mortgage business. While income growth still has a great deal of catching up to do, housing activity has nevertheless rebounded quite impressively. Sales of new and existing homes have risen 70 and 45 percent respectively from their lows last year, and housing starts are up more than 60 percent over the same period.

Indeed, from all indications it would appear to be business as usual these days in the homebuilding and mortgage lending industries. More homes are being built in an environment of reduced -- if not exactly low -- interest rates, and thrift institutions are financing home purchases with long-term, fixed-rate loans. However, there are several large clouds on the horizon. To begin with, the prospect of $200 billion budget deficits stretching far into the future casts serious doubts about the sustainability of a favorable interest rate environment beyond next year. Furthermore, if renewed rate pressures do develop, depository institutions will be forced by the short-term nature of their deposit liabilities to shut off the mortgage lending spigot just as fast as they turned it on this past winter. Finally, even if rates do stay down thrifts are likely to modestly diversify their portfolios away from mortgages in order to limit their interest rate exposure and to take advantage of newly authorized investment powers.

What does this all mean for the housing outlook over the next 5 to 7 years? On the demand side, conditions generally appear to be favorable. In the short run, there is considerable pent-up demand from those households who postponed purchases in the early 1980s. Some of this has already shown up this year, and it will undoubtedly continue well into 1984. Over the longer haul, though, the trend is a little less clear. Although the rate of household formation will be held down somewhat by a slowing in the growth of the adult population and by a likely decline in the divorce rate, a larger percentage of the population will be shifting into age and income brackets where families typically buy new homes. On balance, we believe that these trends, when combined with normal replacement demand and allowances for vacancy, should justify a level of housing starts of about 1.7 million per year over the rest of the decade. This should support the employment of about 2 1/2 million people in construction and construction-related industries, and an unknown, but substantial, further number in other sectors via the complementary consumption and multiplier mechanisms I described earlier. In terms of the total impact on GNP, we would estimate that the direct and induced expenditures related to residential construction would amount to roughly $225 billion on average in 1983 dollars. This is about 6 3/4 percent of GNP.

However, I would like to stress again that in order to reach this potential, financing must remain affordable and available. This requires first that the government's enormous borrowing needs be reduced in order to keep interest rates down. Second, regardless of the future course of interest rates we must also help the mortgage finance industry devise new institutional and regulatory frameworks to operate efficiently in a deregulated environment. Changes in financial conditions and the deregulatory process have left the existing mortgage financing system with an outmoded delivery structure which clearly needs to be retooled, and retooled quickly. If these two challenges are successfully met, I am confident that housing can and will hold its own as a strong force for economic growth. If they are not, housing activity will undoubtedly falter, and growth in employment and production will suffer as a consequence.

I would be pleased to answer any questions you might have.

Mr. **Gephardt**. Mr. Walgren.

Mr. **Walgren**. Thank you, Mr. Chairman.

I would like to just explore with Mr. Hirschhorn these figures. Here in the steel industry we went from 700,000 down to 250,000 employment at a time when apparently there has been not very much dropoff in total capacity, so that reflects a considerable degree of technological innovation. So, here is an industry where employment, even with technological innovation, has fallen by over half, probably two-thirds, or thereabouts.

Are there comparable expectations for other industries?

Dr. **Hirschhorn**. I think so. I think the steel industry really presents an interesting historical case study where you pay a price for technological innovation and change. That price is reduced employment. Clearly also in the case of the steel industry you have had an extremely slow growth rate; in fact, if any growth in steel demand. Even if there has been an increase in steel demand, we have seen imports taking a much higher fraction of the domestic market. So that is a complication too.

I think, in general, it does represent a typical situation; that is, modernization, technological innovation leads to reduced jobs unless you can offset that with a very rapid growth in market. That has not occurred in the case of steel.

Mr. **Walgren**. So, in a sense it is a little bit like the advertisement for the insurance company where there is some kind of impending doom behind the character with his back turned and the first one is saying, "Who is your insurance company?"

Is that the message for other industries in other parts of the country that we should be thinking about?

Dr. **Hirschhorn**. I think so. I think there is an evolutionary series of changes that industries go through. I think the steel industry is at the leading edge of this kind of evolution. Other industries—and we have seen it already, actually—other industries are facing the same sort of problems.

Mr. **Walgren**. What can be said about the research and development efforts in the steel industry?

You are indicating that the specialty steel and alloy operations have been very heavily modernized with substantial commitments in research and development, and that that industry truly is in every sense equal to the specialty steel industry around the world.

Yet they are having their problems with imports. What is the outlook on imports there?

Can you give us some indication of the difficulty that imports are providing the specialty steel industry?

Dr. **Hirschhorn**. I think a good example is where the alloy specialty steelmakers in the United States have done everything right. They invested in R&D, modernized; they have the best plant, best technology, good workers. They have sophisticated, high quality products, but they have been severely impacted by imports from a number of foreign steel industries.

So technology alone is not the answer. This is a good example of that. There has been an increase in demand for alloy specialty steel products. There will be an increase probably in that area for steel, but again the uncertainty is what fraction of our market will be captured by foreign competition.

The foreign competition is no better technologically and a lot of it is probably—really involves unfairly traded steel. There is just no doubt about it. I think it is also interesting to note that although I have said the main part of our industry, the integrated steel industry, has undergone profound technological change, remember that the extent of that change is not as great as in some of our—some of the foreign steel industries that compete with us, so what I am saying is that there is going to be a lot more of that same technological change here which will really lead to loss of jobs.

Mr. **Walgren**. But the reduction in jobs without the reduction in output is truly striking. You would wonder whether other industries are going to be able to increase their productivity to the degree that the American steel industry has increased its productivity as represented by those employment numbers.

Dr. **Hirschhorn**. Well, again it is a complex situation. The mini-mill phenomenon has had a lot of effect on this situation. Not so long ago, mini-mills only accounted for perhaps 1, 2, 3 percent of domestic steel production. Today they are pushing 20 percent of domestic steel production.

Every time you move steelmaking from integrated companies to minimills, you lose tremendous numbers of jobs because the labor productivity in minimills may be three to four times greater than the labor productivity in integrated mills.

So that growth of minimills during the last 10, 20 years, has had a profound effect on the total level of employment in the industry, but it allowed us to continue to make steel.

Mr. **Walgren**. Where do those productivity increases come from with respect to minimills versus the integrated?

Dr. **Hirschhorn**. A large advantage derives from the fact that minimills do not convert iron ore to iron. They use ferrous scrap. In the United States, we have the largest supply of ferrous scrap in the world. So one of the basic ideas that people use when they started to create minimills, they said to themselves, why should we spend all this money converting iron ore, coal into other materials when we can buy ferrous scrap and use it directly in furnaces?

That is exactly what they did.

Mr. **Walgren**. This is recycling and remanufacturing, in a sense?

Dr. **Hirschhorn**. It certainly makes use of an abundant resource that is here.

Another thing, of course, they used more advanced technology extremely rapidly. Almost all the steel made by minimills is continuously cast compared to, again, about 15 percent in the integrated companies.

I can say unequivocally that the cost of making steel in our minimills is about the lowest in the world. They are extremely sophisticated and efficient.

Mr. **Walgren**. Let me ask you—and I don't mean to impose on the time of the other members—we have made certain efforts through the EDA to federally assist some efforts in the steelmaking area. It is my understanding that in some of those efforts the substantial Federal dollars have been eaten up by interest costs.

Do you have any assessment of whether or not we have been successful as a Federal Government in directly aiding manufacturing operations in this area, or have we simply financed the banks?

Dr. **Hirschhorn**. I would say that virtually everything the Federal Government has done during the last several decades to help the steel industry has failed. Not one of the actions taken by the Federal Government has been successful, whether it be the EDA loan guaranty program, the trigger price mechanism, quotas, environmental protection sort of relief; whatever has been done has not changed the basic trends in the industry, trends that include, by the way, diversification out of steelmaking by the major steelmaking companies, and that will probably continue.

As I say, we will see more plant closings and I doubt whether any of the efforts that people are thinking about today would have any dramatic effect on these trends.

Mr. **Walgren**. Thank you, Mr. Chairman.

Mr. **Gephardt**. Thank you, Mr. Walgren.

Could anything have changed those trends in your view?

Dr. **Hirschhorn**. I think that the success of the minimills demonstrates something. The minimills have been successful in a period of history when steel demand has not increased dramatically. They have been in exactly the same country, the same environment that the big steel companies have been in, and yet minimills have been successful and integrated companies have not.

I think that people have to understand the real critical parameter here is the quality of management of corporations. What we see in the case of minimills is excellent managers, risk-takers, people who believe in using technological innovation and using it quickly; people who adapt to change.

We do not see those characteristics in the management of large steel companies. Thus, I think it is erroneous to think that Government policy is going to compensate for bad management.

Mr. **Gephardt**. Do you think that that explains why there has been such a trend in those larger companies to invest in other endeavors than steel or to reinvest in steel?

Dr. **Hirschhorn**. Well, not all of the larger companies have pursued diversification. Most of them have.

I would point out that even though some of the largest companies have pursued diversification, their corporate balance sheets don't reflect any profound improvements as a result of that diversification.

Diversification has been studied in a number of universities, a very good study at Harvard a number of years ago.

Generally diversification has not been successful for corporations and has not been successful in most of the steel companies pursuing that strategy. I think that is just a historical fact.

Mr. **Gephardt**. I look at your figures. I guess I think that this looks better than I expected. In 1953 we had 682,000 people employed in steel and in 1983 we have 242,000. At the end of your statement you say that we will probably increase productivity more and will have reduced employment, but you say we will bottom out at 200,000.

At least we are not getting a lot worse. It is not going on down too much further.

Dr. **Hirschhorn**. I think that we will reach some sort of equilibrium. Again, there are uncertainties here. Imports remain a tremendous problem, but I think that we will see an equilibrium because we will see those steel companies that remain in the business, they will be modernized; they will have the best management, and they will be competitive with foreign steel.

Mr. **Gephardt**. Is there a big tie between the future of the auto industry in America and the future employment levels and production levels of the steel industry?

Dr. **Hirschhorn**. Oh, absolutely.

The automotive market has been perhaps the biggest, most important market for steel in the United States. So the decline in auto sales, as well as the down sizing of automobiles, has had a very dramatic effect on steel demand here.

Mr. **Gephardt**. As well as imports?

Dr. **Hirschhorn**. I was just going to say—the interesting thing about imports is that they increase our supply of ferrous scrap. A lot of people miss that aspect. The benefit to that side—the minimills capitalize on that. We keep increasing our supply of ferrous scrap which makes it easy for the minimills to expand.

Mr. **Walgren**. I just have to perk up my ears when we say this looks pretty good to me. The difficulty, of course, is obvious. If the same thing happens in lots of other industries, then we wonder where these people went and is there some place for them to go. Of course, that is the other side of the equation we hope to develop in these hearings, some sense for the pickup of these people that are displaced or the lack thereof.

I can just say from Pittsburgh's standpoint right now, we have got an awful lot of people who have absolutely no place to go. It has caused documented suicides and great hardship on families that are poorer now than they would have been had that employment not declined.

It has been shown that even in the industries that are most criticized as being obsolete, they have made major steps forward. Yet even that was not enough to maintain their employment. If that employment is not maintained, we are all going to be in a lot of deep trouble.

Mr. **Bedell**. Will the gentleman yield?

Mr. **Gephardt**. Surely.

Mr. **Bedell**. I think what Mr. Hirschhorn is suggesting is, we import Datsuns, melt them down into steel, and give our own workers jobs making automobiles.

Dr. **Hirschhorn**. Not quite.

Mr. **Gephardt**. I didn't mean to suggest this was a rosy picture. I guess what I was saying somewhat frivolously is, some people are saying there will be no steel industry in the United States, no jobs at all. When you look at these numbers, you could come to that conclusion—employment went from 680,000 to 242,000 in 1983. If that kind of decline continues, you at some point hit zero. So I guess I am reassured to some extent that at least there is something going on and some feeling on your part that we could hold at that level.

It doesn't mean we can't do better than that, but at least it is not as bleak as some would paint it.

Mr. **Walgren**. It would be a real warning to other industries that expect the same kind of technological change in their operations to see what has happened to employment in this industry that has been making those changes.

Mr. **Gephardt**. To dig harder at the auto/steel tie, do you have off the top of your head numbers for how much steel the domestic auto industry uses, U.S. manufactured steel?

Dr. **Hirschhorn**. That used U.S.-made steel?

Mr. **Walgren**. Yes.

Dr. **Hirschhorn**. Our auto industry uses mainly domestic steel.

Mr. **Gephardt**. Eighty, ninety percent U.S. steel?

Dr. **Hirschhorn**. Again I am sort of guessing at that because of the location of the automotive manufacturing plants, that is not on the coasts of the country, foreign steel hasn't made the inroads there they have made in other industries.

Mr. **Gephardt**. How much of the U.S. steel output is taken up in auto manufacturing?

Dr. **Hirschhorn**. Again, that is changed so dramatically because of all the cyclic effects. It is probably on the order of 10, 20 percent. It is probably the single largest market in terms of industries.

Mr. **Gephardt**. So, to some extent the future employment levels in U.S. steel will be dependent upon the path for automobile manufacturing in the country?

Dr. **Hirschhorn**. Oh, there is some definite linkage there. Again, it is a very complex situation. People had forecast some years ago that aluminum was going to really replace steel in automobiles. Really that forecast was totally incorrect. If you go back and examine it, it just hasn't happened that way because the costs of making aluminum have increased markedly over the years too.

The same thing with plastics. A lot of people were forecasting plastics would replace steel all over the place. Those substitutions have not taken place as dramatically as most of the forecasters said they would; but they are taking place.

It is a slow evolutionary kind of change.

Mr. **Gephardt**. Mr. Howard, at the end of your statement you say that although the rate of household formation will be held down somewhat by a slowing in the growth of the adult population, and by a likely decline in the divorce rate, a larger percentage of the population will be shifting in the age and income brackets where families typically buy new homes.

If what I have read about demographics is right, beginning in 1962 we had a baby bust, and if my math is correct, that baby bust group is about to hit the home buying age. Can you elaborate on this? Are you saying that people wait to buy until they are 30 or 40 and that that group is still large?

Mr. **Howard**. Yes. There really are two effects there. The postwar baby bulge moved into the 24 to 34 age bracket really in the last decade. People in the 33 to 44 year bracket, if they have not bought their first house—which many of them could not afford to do—they will do that. If they have bought a first home, the 35 to 44 year age bracket is typically the group where people want to buy more housing because they are forming their own family and they are demanding larger homes. Those homes really haven't been built. A lot of the activity in the last 5 years was on the starter homes, the lower end of the market.

So, the people in that group will be buying larger homes, moving out of the smaller homes, and those who have not been able to afford housing because of the higher price, and high rates, will in turn concentrate their efforts on the relatively less expensive homes with fewer amenities.

So, in terms of overall housing services and amenities, it is really a movement from a low consuming group to a higher consuming group.

Mr. **Gephardt**. When that baby bust group hits the 25 to 35, or 35 to 45 age period, we are going to have these—these numbers are going to have problems, aren't they?

Mr. **Howard**. No, that is the slowing of the growth in the adult population I referred to. That is why we are looking at 1.7 million, not 2.2 million, which might have been justified in the 1970's had the financing been more reasonable and prices not been so high.

The demographics for home buying were more favorable in the 1970's and housing starts averaged higher as a result than they will in the eighties. They didn't average as high as they might have because of the price and the rate problem, particularly later on in the decade. Some of that demand will be deferred and pushed over in the eighties, which tends to make the relative starts levels look a little more equal.

Still, because of the demographic problem you pointed out, housing starts in this decade ought to be less.

Mr. **Gephardt**. So your figures are, you think, consistent with the demographic projections, given that these other outside obstacles that you have mentioned are taken care of in some fashion?

Mr. **Howard**. Not eliminated, but resolved in a more reasonable fashion than they appear to be now.

Mr. **Gephardt**. Do you take into account any shift in attitudes about single family homes and people's desire for them?

Mr. **Howard**. I think you will find a little more desire to rent versus owning in the eighties certainly than in the latter half of the seventies.

You had a pickup in housing purchasing, not necessarily living in a home, because people owned one or two or three homes late in the 1970's.

A lot of people who really could not justify paying the monthly payments simply to live in the place, wanted it for an investment vehicle. So, those homes are going to be on the market in the 1980's to a greater extent.

In a relative sense, you should have more renters than homebuyers.

Let me point out one other thing that may not be clear in comparing the 1.7 number to the 1970 starts of 1.76 million.

We are ignoring starts in 1980, 1981 and 1982, which amounted to 1.25, 1.,06, and 1.1. If you roll that together, your average for the decade will be lower than 1.7. Part of the 1.7 is the pickup from the abysmally low levels we just came out of in the last 3 years.

Mr. **Gephardt**. Thank you.

Mr. MacKay.

Mr. MacKay. Dr. Lund, I thought all three of these presentations were extremely thought-provoking. It seems to me you are saying, Dr. Lund, that in the past America's technology has created all kinds of disruptive effects in other societies.

We have sort of said in a judgmental way, we don't know why you all can't deal with that. It has always been coming from us to them. Now we are getting it back for the first time.

It seems to me the thrust of your paper is that we ought to be adopting policies that would allow for the disruptive effects of technology to be less disruptive on our work force in any event.

I have wondered for some time why we couldn't at least do some of the basic things like having a nationwide system of job information. My understanding is, we have the legislative authorization for that in the Department of Labor, but they have never really implemented it.

My understanding is that information is mailed in to a nationwide center. They don't use the computer they have. They don't tie them together. They mail them in. Some day the information becomes available at a point when it is really not useful. Have you looked at that?

Mr. Lund. No, I have not. It is my impression, as it is yours, that we are using old technology in an era when we really badly need to use the kinds of communications technology, the kinds of computer technology that really could improve mobility of workers from places where jobs are in surplus to places where jobs are, in fact, available.

We would not see the kind of frustrating migrations to Houston and other places in the hopes of jobs only to discover those jobs do not exist.

Mr. MacKay. Do you see this perhaps in terms of a next generation when suddenly all nations—us included—realize that we have a common problem?

In other words, what you are saying is, let's see if we can adopt policies that although we have become less labor-intensive, we can still create enough jobs. However, the net effect of that is going to be to increase the disruptive effect of our technology on other nations, is it not?

It seems to me that is the direct implication of your statement. That is, if we can make labor less and less of a factor, then we can become more and more competitive. It seems to me the other side of that argument is we are going to create greater and greater disruptive impacts on other nations who happen to be nations we are supporting.

What I am saying is, if we were to look at that on the basis of the nations that are buying from us and we are loaning them money to buy, and loaning them money to pay the interest. We keep hoping they continue, and we pretend it is not all tied together.

Is your policy a long-term policy or a short-term policy?

Mr. Lund. I would say it is long term in that we are not only supporting many countries, but we are also competing with many countries, and unless we are able to compete effectively with those other countries, we will not be able to support the countries that are dependent upon us.

We need to upgrade our technology as rapidly as any other country is able to do. We need to make the transitions in terms of the skills required for the jobs that are going to be developed, and in terms of the products that can be innovated and presented to the market as rapidly as any of our competitor nations.

As a matter of fact, we perhaps ought to be moving more rapidly because we have been so slow out of the starting gate.

Mr. **MacKay**. I am saying this in the sense that we are now suddenly realizing that all of us are subsidizing our agriculture and that if we all keep doing that, we are all going to be broke. So finally, we are all beginning to realize we can't keep competing in that area and we have to adopt some fairly common worldwide agricultural policies.

I am saying you are recommending that we go down a road that is going to lead us to that same conclusion, is it not, in industrial production, or do you see that as an implication?

Mr. **Lund**. I think we need to be intelligent in the way we go down a road. We need to understand what technology can do for us as well as what it does to us, and that means managers who understand technology and managers also who understand what the human needs are in manufacturing and in other places where new technology is being employed.

The real issue of where we go with technology in the long run is that we make the intelligent use of that technology.

Mr. **MacKay**. I am not sure there is an answer to the question I asked. I didn't mean it to indicate that I am adverse to your thoughts. I think you made some very constructive suggestions about portability and making job changes less disruptive.

Mr. Howard, I have been involved in my other life in the S&L industry and in property law in Florida which is growing very rapidly. What you described is what is going on. I have no problem with that, but it seems to me you are discounting the possibility of technology making any major breakthroughs in housing.

I want to ask the question in this way: It seems to me your paper says that there is a great deal of price elasticity in housing. It seems to me what you said is because interest costs went up that the cost of housing became a greater percentage of people's income and, therefore, a lot of people were priced out of the market, the implication of that being if the price of housing can come down, then the problem changes again.

Now, labor is a big component. You seem to mention that in saying this is how many jobs we created. It seems to me there will be a tremendous incentive in manufacturing housing as more and more people look at this to try to produce a product with less labor costs and less square foot costs. I guess what I am saying is, that you seem to conclude that is not going to happen in your industry, although Dr. Hirschhorn said that is exactly what has happened in steel. Why is that, except for the fact that organized labor has managed to keep us from dealing with the real world?

Mr. **Howard**. There, Mr. MacKay, are a host of implications to your question.

Let me address two or three of them.

As regards the price elasticity of housing, that is a tricky issue. Take late in the 1970's when the faster prices rose, the more people wanted to buy a home. That is backwards. If that is how you sell houses, that is a heck of a business.

What was happening is, people were buying it for investment purposes. That was a function of relatively inexpensive financing.

Once housing prices leveled off, as they have done, and given the new structurally higher interest rate level, it is going to cost more to buy a home. I think people will adjust to that. Home ownership is a very important goal. They simply will devote more of their resources to servicing a debt on that home. In my judgment we are not going to go back to the 15 or 16 percent of after-tax income servicing a mortgage on a typical home.

The inflation in home prices is higher and, more importantly, financing costs are higher. I think the public will adjust to that.

My comments on the impact of technology on housing weren't designed so much to downplay the implications of that, but simply to say that, looking at the total employment picture, both in terms of the housing industry per se, and related industries and the ripple effect, the technological impact is swamped by whether or not you build a lot of houses or not very many houses. That, in turn, is a function of interest rates and the financing system. I think in terms of looking at overall housing employment you really have to focus on that big problem.

Are we creating an environment that allows homes to be built and financed affordably?

Speaking to the technological issue per se, which is the last point I want to make, if I am right that the 35- to 44-year-old people are going to be buying relatively more expensive houses with more amenities, manufactured housing is less economical in that size range and amenity range.

Again, remember, you are dealing with one-third of the jobs that are related onsite. Some of those can be reduced or productivity can be enhanced by manufactured housing that results in less onsite labor, but you still have to clear the land; you still have to pour the foundation; you still have to put it together. The savings overall are not trivial, but looking at it in the broader context, which is what I was attempting to do here, it is something that does get overwhelmed by these other factors that I mentioned.

Mr. GEPHARDT. Representative Bedell, I think we have a couple of minutes.

Mr. BEDELL. If you have 2 minutes?

Mr. Howard, I take it from your answer to Mr. MacKay, you do expect improvements in productivity in housing, but you don't think they will be particularly dramatic, is that correct?

Mr. HOWARD. Yes. Let me quickly tag one thing onto that. That was the fourth thing I wanted to get to.

If you are looking for productivity increases, more than looking at manufactured housing versus hammer and nails, the costs of inefficient State and local regulation is the place to concentrate your efforts.

Mr. BEDELL. You do expect there to be some improvement, I take it, in productivity?

Mr. HOWARD. In both areas, yes.

Mr. **Bedell.** Do you expect there to be more multifamily units built or fewer as a percent of our housing in the eighties compared to the seventies?

Mr. **Howard.** Fewer.

Mr. **Bedell.** You indicated there will be fewer units built in the eighties than the seventies? The thing I wanted to point out to the committee is, in the Bureau of Labor Statistics they project that the most, greatest increase in jobs available will be carpenters.

They project that there will be 173,000 new jobs for carpenters, which approaches the total number of jobs in the steel industry. I believe that is subject to question when we look at what is happening in housing. If we are going to build fewer houses, if we are going to have more manufactured housing, I question very much whether that is a projection we should accept without question.

Mr. **Gephardt.** Maybe the carpenters can melt down the Toyotas.

I want to thank the panel very much. You have been excellent and helpful.

We will return as quickly as possible to go to the Emerging Industries panel.

[Recess.]

Mr. **Gephardt.** If we could come to order.

We have got time constraints at this point. I apologize for that. It is sometimes inevitable and we haven't had any cooperation from people who have been asking for less than important votes, but as you know, our voting record is looked at as if every vote is important, even though many of them are not.

We have a very important panel on emerging industries. I guess I am going to be asking you to rip through your testimony as fast as you can so that we can have some time for questions. We are going to lose this room in an hour. We are probably going to lose some Members before then. So we really beg you to be concise.

First, Professor Almon, Professor of Economics, University of Maryland.

[The biographical sketch of Dr. Almon follows:]

VITA

Name: Clopper Almon, Jr.

Born: 25 January 1934, Nashville, Tennessee

Education: Public Schools of Sheffield, Alabama, completed 1952
Vanderbilt University, B.A., 1956
Harvard University, M.A., 1961; Ph.D., 1962

Employment: Lieutenant, U.S. Army, 1957-1959
Instructor, Harvard University, 1962-1966
Associate Professor, University of Maryland, 1966-1968
Professor of Economics and Director, Interindustry Forecasting Project, University of Maryland, 1968-Present

Books: *The American Economy to 1975*, Harper and Row, New York, 1966.

Matrix Methods in Economics, Addison-Wesley, Reading, Mass., 1967.

1985: Interindustry Forecasts of the American Economy, Lexington Books, D.C. Heath & Company, Lexington, Mass., 1974 (with others).

1973-1975 In Figures, Lexington Books, D.C. Heath & Company, Lexington, Mass., 1974 (with others).

Professional Responsibilities:

Chairman, Executive Committee of NBER Conference on Research in Income and Wealth, 1976-1977.

Co-ordinator for Econometric Modeling, US-USSR Exchange Program on Science and Technology, sponsored by the National Science Foundation.

U.S. Chairman of Joint US-USSR Seminar on Econometric Modeling. May 1978 and October 1981.

On leave 1978-1979, to work at the International Institute for Applied Systems Analysis, Laxenburg, Austria.

STATEMENTS OF DR. CLOPPER ALMON, PROFESSOR OF ECONOMICS, UNIVERSITY OF MARYLAND: DR. MARC BENDICK, JR., DIRECTOR, PROGRAM ON ECONOMIC CHANGE AND THE AMERICAN WORK FORCE, THE URBAN INSTITUTE: AND BETTY M. VETTER, EXECUTIVE DIRECTOR, SCIENTIFIC MANPOWER COMMISSION

Dr. ALMON. Thank you, Mr. Chairman. I am one of those computer users and economists who have been advised earlier today that they should get away from the computers and get back to reality. Yesterday morning I was trying to find my way to a small town in eastern Pennsylvania and got hopelessly lost in the metropolis of West Chester. I knew a lot about the real world; I could see there was a grocery store here, a drug store there, but what I needed was to know more than the eye could see. I needed a map, a theory, a model. Finally, somebody who knew more than that real world immediately around us got me on the right road.

I think there is a danger in overemphasizing what we immediately see and in supposing that we do need to be able to look at what is not apparent. That is what I want to try to look at this morning.

The particular model that we are going to use is called the inforum model. It has been used by industry for over 15 years in establishing forecasts. It includes forecasts for employment and labor productivity. In the particular use of it that I want to describe to you this morning, we tried to ask the question: "What happens if there is a tremendous change in labor productivity?"

We said, in fact, let us double the trend growth rate of labor productivity, not just in one industry or another industry, but in all industries in the economy.

Coming at the end of a decade of continually slowing productivity, this sort of change is revolutionary. We wanted to ask, "What happens?" Now, our theory would lead us to expect that the jobs that were lost in some industries would be picked up in other industries. The wages one man loses becomes income to someone else which he can spend, which creates jobs elsewhere.

The analogy we have heard this morning between today's workers and horses when tractors were introduced neglects the fact that the horses didn't adapt very well to the new situation. People aren't horses; they are very capable of adapting to new situations. But, of course, adapting may be painful.

The results of our calculations with this model are shown in great detail in the tables you have. I will not take you through them, but will describe some of the summary results. By 1990, under the revolutionary changing technology, the GNP is 5 percent higher than it is with our standard trend projections. At the same time, unemployment is 1.3 percent higher, going up from 4 percent to 5.3 percent. Thus, it is true—and our model shows this—that with this sort of revolutionary change in productivity, there will be additional friction, there will be people who do not find jobs immediately.

If we say, however, that the 1.3 percent unemployment could have—had it been employed—increased GNP by 1.3 percent, then we could say that the boom in productivity increased potential GNP 6.3 percent, and that we were able to effectively use 80 percent of that additional potential while 20 percent of it got lost in increased frictional unemployment.

If we went further into the future, I think the 20 percent would diminish rather than increase. By the way, much of the increase in the GNP, 50 percent, was in personal consumption expenditures, 40 percent of it was in investment goods, and 10 percent was in increased exports. Within the consumption goods, it was particularly the durables which grew faster. They reached a level 7½ percent higher in 1990 with the increased labor productivity.

That rise, translated into industrial impacts, implies that there would be gains in employment under the fast productivity change in such industries as construction, fabricated metal products, metal working machinery, miscellaneous non-electrical machinery, TV sets, radios, phonographs, and the aerospace industries, which are all durable goods industries. But the big gains in employment were not in the machinery industries; they were not in the high tech industries; they were in such traditional industries—which can hardly be called emerging industries—as retail and wholesale trade, finance, insurance, hotels, business services, repairs, automobile repairs, entertainment, medicine, and—I was glad to note—education.

Table 3 (page 327) of our results shows the impacts on individual industries. In particular, the electronics industries themselves have shown in the past decade rapid increase in productivity, so that when we doubled their rates of growth, their employment came out smaller under our increased productivity scenario rather than under the base one. That was simply because the model was not informed that the higher productivity was brought about by buying the products of these particular industries.

We could remedy that matter if we had a little longer to work on our results, but it actually makes our basic point stronger, namely, that even without the gains in employment in the electronics industry, no massive unemployment occurs as a result of vast increases in productivity. If we had put in bigger demands on electronics, we would no doubt have gotten even higher employment. I would like to emphasize, therfore, that it is not really appropriate to ask whether the additional jobs will be found in the industries making the chips. One hopes not, because if that is where the jobs all come, then we have not gained anything; there's nothing left over that increases our standard of living.

The relevant question is whether people replaced by the chips can find employment elsewhere, and our answer to that is predominantly yes, although some substantial adjustments would be necessary.

So, in summary, we do not believe that the electronics revolution poses a major threat of massive unemployment.

[The prepared statement of Dr. Almon follows:]

EFFECTS OF FAST PRODUCTIVITY GROWTH ON EMPLOYMENT 1982-1990

Remarks of
Clopper Almon
and
Margaret B. Buckler

before the
Science Research and Technology Subcommittee
Committee on Science and Technology

and the
Task Force on Education and Employment
Budget Committee
House of Representatives
U.S. Congress

June 9, 1983

We have been asked to comment on the effects of the chip and the expected revolution in information processing and computer aided manufacturing on the outlook for employment and unemployment between now and 1990. In preparing our reply, we have made use of a great many chips and a lot of information processing to calculate with one of the most complete and comprehensive econometric models available today. Yet the message which emerges from our calculations is plain and simple:

There may be many causes for concern about the proliferation of computers, robots, and other offspring of the silicon chip, but massive unemployment is not one of them.

This simple point could be argued historically -- technological change in the last century has made virtually every manufacting skill of 1883 useless today without producing massive unemployment. (Our present 10.1 percent unemployment rate, coming after a decade of almost zero aggregate productivity increase, cannot be blamed upon automation.) Or it could be argued theoretically by asking what happens to income and aggregate demand when a job is eliminated by a machine. (The funds not used for wages go to create jobs elsewhere; if the worker can adapt to the new situation, he can find another job.) Or it can be argued by experimentation with a detailed model of the economy. Because it is our particular specialty, we will use the model approach.

At the outset, we should make plain that, though we are no strangers to computers and information processing, we are by no means experts in computer- aided manufacturing or robotics. Nor have we had the opportunity to study this subject intensively before preparing this testimony. Instead, we have simply asked, What happens if this year a revolution begins in productivity growth? Which industries will gain in employment? Which will lose? What effects will there be on aggregate employment?

The model we have used to answer these questions, Inforum, is an interindustry macroeconomic model particularly well suited for this task. The Inforum project has provided economic forecasts with industry detail to business and government for over fifteen years. The model distinguishes some 75 products grouped into 60 industries employing workers. It fully integrates wages, prices, and demand. An increase in productivity in a particular industry is automatically translated into a price reduction in that industry. That price reduction both increases aggregate purchasing power and directs more of it to the industry with the price reduction.

The labor productivity equations in this model have time trends and cyclical factors. The precise form of the question we put to the model was: What will happen to employment in each of the industries of the model if the trend growth rate of productivity in each industry should prove to be twice what recent experience would lead us to expect?

Such a change in growth rates would certainly be revolutionary, given the steadily declining growth rate of productivity over the last decade, which has certainly seen a vast reduction in the cost of computing power. We are not saying that this revolution is likely on the basis of robotics or any other innovation. We are only asking what would be its effects if it occurred. What seems more probable is that such a change may occur in a few industries. By considering the case in which the revolution affects all industries, we are looking at the extreme case, the most alarming case for those fearing massive unemployment.

The results of our calculations are shown in detail in the accompanying tables, where BASE indicates our standard forecast and INCREASE indicates the runs with the increase in productivity.

The aggregate results appear in Table 1. By 1990, real GNP is 5 percent higher in INCREASE than in BASE. At the same time, unemployment is 1.3 percentage points higher in INCREASE, thus realistically reflecting the greater adjustment strains in this scenario. If we say that employment of this 1.3 percent of the labor force would increase GNP by roughly 1.3 percent, then we could say that the revolution in productivity growth would add 6.3 percent to our real GNP by 1990. Eighty percent of this growth gets converted into greater real product and twenty percent gets lost as increased frictional unemployment. If we went further into the future, the percentage lost would decrease.

Half of the additional GNP goes to personal consumption expenditure, especially to consumer durables, which are 7.5 percent higher in INCREASE than in BASE. Forty percent of the extra GNP goes to investment, and ten percent to increased exports. The rate of inflation is lower in the high productivity run than in the base case -- 3.1 percent per year versus 3.3 percent. Interest rates are lower in INCREASE -- 7.3 versus 8.6 in the AAA corporate bond rate.

Table 2 shows employment by industry and its growth rates between 1982 and 1990. The boom in investment and consumer durables translates into growth in employment in Construction, Fabricated metal products, Metal working machinery, Miscellaneous non-electrical machinery, TV sets, radios, and phonographs, and Aerospace. The big gains in employment, however, are in the Service industries such as Trade, Finance and insurance, Hotels, Business services, Repairs, Entertainment, Medicine and education. Most other industries have smaller employment in INCREASE than in BASE. Table 3 shows productivity indexes for each industry.

In particular, the electronics industries themselves come out with a smaller employment under INCREASE. This result appears because the model was not informed that the higher productivity was brought about by buying the products of these industries. We could remedy that matter, but the present calculation actually gives us a stronger case for our basic point, for even without gains in employment in the electronics industries no massive unemployment occurs as a result of a vast increase in productivity. If we tied the increase in productivity to expenditures on electronics, we would get even higher employment in INCREASE. We would like to emphasize, therefore, that it is inappropriate to ask Will the workers replaced by chips be put to work making chips? One hopes not. That would not increase our real income. The relevant question is whether people replaced by chips can find employment elsewhere. Our answer is predominantly "Yes," though some adjustments would be necessary.

We do not believe, therefore, that chips pose a major unemployment threat.

IMPACT OF INCREASING PRODUCTIVITY   TABLE 1. GROSS NATIONAL PRODUCT   (1972$)

	BASE 1977	BASE 1982	BASE 1990	INCREASE 1990
Gross National Product	1373.47	1478.54	1900.71	1996.86
Personal Consumption Expenditures	864.28	949.94	1224.24	1272.19
Durables	137.93	137.70	198.08	213.30
Non-durables	333.37	361.53	438.18	450.72
Services	392.97	450.71	587.98	608.17
Gross Private Domestic Investment	213.19	196.60	305.02	344.06
Structures	99.31	91.44	132.92	147.03
Residential	58.78	39.17	67.54	73.88
Non-residential	40.53	52.27	65.38	73.15
Producers' durable equipment	101.54	112.65	160.56	183.09
Inventory change	12.34	-7.49	11.54	13.93
Exports of goods & services	115.05	151.42	177.57	190.63
Merchandise (producers' prices)	60.42	71.71	91.33	100.40
Transportation, trade , services	25.62	33.16	40.60	42.94
Rest of world	29.00	46.54	45.64	47.28
Imports of goods & services	91.44	111.46	146.49	149.97
Merchandise(domestic port price)	66.76	70.46	101.22	104.69
Petroleum & natural gas	9.30	5.59	8.52	8.75
Transportation, trade, services	17.83	21.20	28.43	29.47
Rest of world	6.84	19.80	16.84	15.81
Government Purchases	272.39	292.05	340.37	339.95
Federal	100.70	116.97	139.55	139.17
Defense	65.17	78.70	103.58	103.21
Compensation of employees	31.90	32.54	34.26	33.88
Structures	1.64	1.77	2.44	2.45
Other	31.63	44.40	66.88	66.87
Non-defense	35.53	38.27	35.97	35.96
Compensation of employees	16.60	14.37	16.30	16.30
Structures	3.67	4.23	4.65	4.67
Other	15.26	19.66	15.01	14.99
State and local	171.68	175.08	200.82	200.78
Education	70.89	72.53	76.35	76.35
Compensation of employees	53.22	56.35	59.36	59.36
Structures	6.51	6.42	8.49	8.52
Other	11.16	9.75	8.50	8.47
Other	100.80	102.59	124.47	124.43
Compensation of employees	44.58	47.78	50.79	50.79
Structures	18.18	18.84	27.03	28.14
Other	38.04	35.92	46.65	45.50
Addenda:				
Unemployment rate	7.05	9.91	4.00	5.34
GNP / Civilian jobs	20.37	20.12	21.74	23.18
(GNP-Govt) / Private jobs	18.54	18.20	19.92	21.57
PCE deflator	1.40	2.09	3.16	2.99
Index, unit compensation, mfg	100.00	152.66	258.15	256.67
Index, unit compensation, oth	100.00	149.03	258.93	262.90
M2 (billions of CUR$)	1234.40	1912.51	3627.04	3627.04
Disp. income per capita (1972$)	4280.20	4555.01	5493.25	5736.96
Savings rate	5.94	6.80	8.14	8.62
AAA Corporate bond rate	8.02	13.79	8.65	7.30

IMPACT OF INCREASING PRODUCTIVITY   TABLE 2. HOURLY ADJUSTED EMPLOYMENT   (MILLIONS OF JOBS)

	BASE 1977	BASE 1982	BASE 1990	INCREASE 1990	SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES BASE 77- 82	BASE 82- 90	INCREASE 82- 90
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TOTAL PRIVATE SECTOR JOBS	78.53	86.10	104.22	102.63	1.84	2.39	2.20
AGRIC, MINING, CONSTRUCTION	8.88	9.79	11.54	11.66	1.95	2.06	2.19
1 AGRICULTURE(1)	3.30	3.23	2.91	2.54	-0.43	-1.29	-3.00
2 CRUDE OIL & GAS (5-6)	0.39	0.58	0.63	0.65	7.64	1.13	1.58
3 MINING (2-4,7)	0.46	0.53	0.76	0.77	2.83	4.51	4.63
4 CONSTRUCTION (8)	4.73	5.46	7.24	7.70	2.86	3.54	4.31
NON-DURABLE GOODS	8.09	7.75	7.70	6.47	-0.85	-0.08	-2.26
5 FOOD, TOBACCO (9)	1.79	1.69	1.56	1.14	-1.12	-1.02	-4.93
6 TEXTILES (10)	0.67	0.59	0.46	0.37	-2.52	-3.07	-5.99
7 KNITTING (11)	0.23	0.21	0.17	0.11	-2.29	-2.27	-7.92
8 APPAREL & HHLD TEXTILES (12)	1.31	1.21	1.23	1.00	-1.61	0.22	-2.41
9 PAPER (13)	0.69	0.65	0.67	0.57	-1.20	0.34	-1.61
10 PRINTING (14)	1.15	1.26	1.39	1.36	1.81	1.26	0.98
11 AGRICULTURAL FERTILIZER (15)	0.07	0.07	0.07	0.06	0.50	-0.05	-1.26
12 OTHER CHEMICALS (16)	1.01	0.98	0.94	0.75	-0.75	-0.42	-3.33
13 PETROLEUM REFINING (17)	0.20	0.18	0.16	0.14	-1.94	-1.68	-3.76
14 RUBBER & PLASTIC PROD (19-20)	0.71	0.69	0.81	0.76	-0.70	2.13	1.25
15 FOOTWEAR & LEATHER (21)	0.25	0.23	0.23	0.22	-1.91	0.09	-0.66
DURABLE GOODS	11.64	11.66	13.85	13.07	0.03	2.15	1.42
16 LUMBER (22)	0.72	0.64	0.72	0.69	-2.43	1.54	0.96
17 FURNITURE (23)	0.46	0.43	0.43	0.39	-1.41	0.08	-1.18
18 STONE, CLAY & GLASS (24)	0.67	0.65	0.83	0.82	-0.69	3.18	2.91
19 IRON & STEEL (25)	0.78	0.65	0.62	0.60	-3.69	-0.66	-1.11
20 NON-FERROUS METALS (26-27)	0.40	0.39	0.45	0.42	-0.55	1.75	1.14
21 METAL PRODUCTS (28)	1.59	1.60	2.06	2.14	0.17	3.17	3.62
22 ENGINES & TURBINES (29)	0.12	0.11	0.13	0.12	-2.11	2.79	1.86
23 AGRICULTURAL MACHINERY (30)	0.15	0.13	0.11	0.09	-2.85	-2.12	-5.03
25 METALWORKING MACHINERY (32)	0.33	0.34	0.43	0.47	0.71	2.92	4.09
27 SPECIAL IND MACH (33)	0.19	0.21	0.19	0.18	1.48	-1.16	-1.64
28 MISC NONELEC MACH (31,34)	0.93	0.99	1.12	1.14	1.29	1.50	1.74
29 COMPUTERS, OFFICE EQ (35-36)	0.32	0.47	0.70	0.48	7.68	5.03	0.44
30 SERVICE INDUSTRY MACH (37)	0.17	0.16	0.21	0.21	-1.38	3.16	3.07
31 COMMUNIC EQ, ELECTRON COMP (38)	0.86	1.08	1.34	1.20	4.72	2.62	1.24
32 ELEC APP & DISTRIB EQ (39)	0.35	0.34	0.34	0.30	-0.90	-0.02	-1.43
33 HOUSEHOLD APPLIANCES (40)	0.18	0.16	0.16	0.12	-2.83	0.61	-3.62
34 ELEC LIGHT & WIRING EQ (41)	0.36	0.36	0.42	0.42	-0.23	2.05	1.85
35 TV SETS, RADIOS, PHONOGRAPH (42)	0.12	0.11	0.11	0.12	-2.84	0.91	1.52
36 MOTOR VEHICLES (43)	0.95	0.72	0.84	0.77	-5.63	2.02	0.84
37 AEROSPACE (44)	0.49	0.66	0.95	1.01	5.86	4.53	5.33
38 SHIPS & BOATS (45)	0.22	0.23	0.32	0.31	0.15	4.56	3.84
39 OTHER TRANSP EQ (46)	0.22	0.22	0.18	0.14	-0.37	-2.39	-5.56
40 INSTRUMENTS (47)	0.62	0.66	0.82	0.65	1.07	2.82	-0.16
41 MISC MANUFACTURING (48)	0.44	0.39	0.37	0.31	-2.26	-0.85	-3.13
TRANSPORTATION	2.98	3.05	3.42	3.06	0.50	1.40	0.02
42 RAILROADS (49)	0.53	0.49	0.47	0.42	-1.75	-0.63	-1.98
43 AIR TRANSPORT (52)	0.39	0.44	0.50	0.45	2.36	1.69	0.36
44 TRUCKING, OTH TRANS(50-51,53-54)	2.05	2.13	2.45	2.19	0.68	1.77	0.37

IMPACT OF INCREASING PRODUCTIVITY   TABLE 2. HOURLY ADJUSTED EMPLOYMENT   (MILLIONS OF JOBS)

	BASE 1977	BASE 1982	BASE 1990	INCREASE 1990	SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES BASE 77- 82	BASE 82- 90	INCREASE 82- 90
UTILITIES	1.94	2.16	2.46	2.01	2.16	1.61	-0.89
45 COMMUNICATIONS SERVICES (55)	1.19	1.33	1.52	1.13	2.12	1.69	-1.98
46 ELECTRIC UTILITIES (56)	0.51	0.57	0.62	0.55	2.33	1.07	-0.41
47 GAS, WATER & SANITATION (57, 58)	0.24	0.26	0.32	0.33	2.04	2.32	2.73
48 WHOLESALE & RETAIL TRADE (59, 60)	20.38	22.67	28.65	29.11	2.13	2.93	3.13
FINANCE, INSURANCE, REAL EST.	4.91	5.58	6.87	6.91	2.52	2.60	2.69
49 FINANCE & INSURANCE (62)	3.67	4.07	5.14	5.19	2.08	2.92	3.03
50 REAL ESTATE (63)	1.25	1.51	1.73	1.73	3.77	1.71	1.71
SERVICES	17.79	21.58	27.97	28.57	3.87	3.24	3.50
51 HOTELS; REPAIRS EXC. AUTO (65)	3.06	3.47	4.26	4.46	2.48	2.58	3.13
52 BUSINESS SERVICES (66)	4.25	5.58	8.17	8.42	5.45	4.76	5.14
53 AUTO REPAIR (67)	0.71	0.86	1.18	1.23	3.69	3.91	4.48
54 MOVIES & AMUSEMENTS (68)	1.01	1.10	1.47	1.57	1.65	3.67	4.46
55 MEDICINE, EDUC, NPO (69)	8.75	10.57	12.89	12.89	3.79	2.47	2.48
DOMESTIC SERVANTS	1.92	1.86	1.77	1.77	-0.68	-0.62	-0.62
CIVILIAN GOVERNMENT	15.51	16.30	17.45	17.43	1.00	0.85	0.83
FEDERAL DEFENSE	0.98	0.98	1.03	1.00	-0.06	0.62	0.28
FEDERAL NON-DEFENSE	1.10	0.95	1.08	1.08	-2.88	1.57	1.57
STATE & LOCAL EDUCATION	6.56	6.94	7.30	7.30	1.12	0.64	0.64
STATE & LOCAL OTHER	5.37	5.74	6.10	6.10	1.36	0.75	0.75
FEDERAL GOVT ENTERPRISES	0.84	0.95	1.08	1.08	2.36	1.56	1.56
STATE & LOCAL GOVT ENTERPRISES	0.66	0.74	0.87	0.87	2.28	2.01	2.01
TOTAL CIVILIAN JOBS	94.04	102.40	121.68	120.05	1.70	2.16	1.99
TOTAL CIVILIAN EMPLOYMENT	92.04	99.30	116.18	114.55	1.52	1.96	1.79
MULTIPLE JOB HOLDERS	2.00	3.10	5.50	5.50	8.77	7.17	7.17
MILITARY JOBS	2.07	2.18	2.35	2.35	1.03	0.92	0.92
CIVILIAN UNEMPLOYMENT RATE	7.05	9.91	4.00	5.34	6.80	-11.34	-7.72
LABOR PRODUCTIVITY							
GNP / CIVILIAN JOBS	20.37	20.12	21.74	23.18	-0.24	0.97	1.77
(GNP-GOVT) / PRIVATE JOBS	18.54	18.20	19.92	21.57	-0.37	1.13	2.12

IMPACT OF INCREASING PRODUCTIVITY

TABLE 3. PRODUCTIVITY: OUTPUT/HRLY ADJ EMPL (1977=100)

					SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES		
	BASE 1977	BASE 1982	BASE 1990	INCREASE 1990	BASE 77- 82	BASE 82- 90	INCREASE 82- 90
1 AGRICULTURE(1)	100.00	105.58	137.25	162.81	1.09	3.28	5.41
2 CRUDE OIL & GAS (5-6)	100.00	76.40	70.00	70.00	-5.38	-1.09	-1.09
3 MINING (2-4,7)	100.00	99.42	90.92	95.20	-0.12	-1.12	-0.54
4 CONSTRUCTION (8)	100.00	82.42	80.56	81.50	-3.87	-0.28	-0.14
5 FOOD, TOBACCO (9)	100.00	107.79	136.65	190.91	1.50	2.96	7.14
6 TEXTILES (10)	100.00	98.61	174.50	243.54	-0.28	7.13	11.30
7 KNITTING (11)	100.00	119.64	204.26	348.94	3.59	6.69	13.38
8 APPAREL & HHLD TEXTILES (12)	100.00	112.44	155.30	208.25	2.34	4.04	7.70
9 PAPER (13)	100.00	109.43	136.29	168.47	1.80	2.74	5.39
10 PRINTING (14)	100.00	92.60	101.46	108.09	-1.54	1.14	1.93
11 AGRICULTURAL FERTILIZER (15)	100.00	114.29	141.51	163.78	2.67	2.67	4.50
12 OTHER CHEMICALS (16)	100.00	110.95	150.43	200.34	2.08	3.80	7.39
13 PETROLEUM REFINING (17)	100.00	101.96	129.90	158.01	0.39	3.03	5.48
14 RUBBER & PLASTIC PROD (19-20)	100.00	104.73	122.70	141.35	0.92	1.98	3.75
15 FOOTWEAR & LEATHER (21)	100.00	85.67	111.47	132.44	-3.09	3.29	5.45
16 LUMBER (22)	100.00	91.30	111.27	127.72	-1.82	2.47	4.20
17 FURNITURE (23)	100.00	99.43	129.54	158.76	-0.12	3.31	5.85
18 STONE,CLAY & GLASS (24)	100.00	101.69	114.46	126.00	0.33	1.48	2.68
19 IRON & STEEL (25)	100.00	101.07	127.21	150.27	0.21	2.87	4.96
20 NON-FERROUS METALS (26-27)	100.00	108.34	132.01	153.90	1.60	2.47	4.39
21 METAL PRODUCTS (28)	100.00	101.13	109.22	115.28	0.22	0.96	1.64
22 ENGINES & TURBINES (29)	100.00	90.81	108.38	129.14	-1.93	2.21	4.40
23 AGRICULTURAL MACHINERY (30)	100.00	96.62	147.90	208.36	-0.69	5.32	9.61
25 METALWORKING MACHINERY (32)	100.00	88.49	90.98	93.47	-2.45	0.35	0.68
27 SPECIAL IND MACH (33)	100.00	75.78	106.82	122.85	-5.55	4.29	6.04
28 MISC NONELEC MACH (31,34)	100.00	89.91	105.76	115.37	-2.13	2.03	3.12
29 COMPUTERS,OFFICE EQ (35-36)	100.00	131.48	162.18	265.43	5.47	2.62	8.78
30 SERVICE INDUSTRY MACH (37)	100.00	103.95	120.99	132.58	0.78	1.90	3.04
31 COMMUNIC EQ, ELECTRON COMP (38)	100.00	109.97	142.19	173.40	1.90	3.21	5.69
32 ELEC APP & DISTRIB EQ (39)	100.00	111.36	150.03	188.28	2.15	3.73	6.56
33 HOUSEHOLD APPLIANCES (40)	100.00	100.10	129.04	191.26	0.02	3.18	8.09
34 ELEC LIGHT & WIRING EQ (41)	100.00	95.33	109.34	120.85	-0.96	1.71	2.97
35 TV SETS,RADIOS,PHONOGRAPH (42)	100.00	126.92	170.00	170.00	4.77	3.65	3.65
36 MOTOR VEHICLES (43)	100.00	86.45	123.53	154.64	-2.91	4.46	7.27
37 AEROSPACE (44)	100.00	91.20	90.04	90.60	-1.84	-0.16	-0.08
38 SHIPS & BOATS (45)	100.00	111.93	124.80	139.29	2.25	1.36	2.73
39 OTHER TRANSP EQ (46)	100.00	92.77	179.32	258.35	-1.50	8.24	12.80
40 INSTRUMENTS (47)	100.00	100.87	121.43	169.29	0.17	2.32	6.47
41 MISC MANUFACTURING (48)	100.00	95.85	150.25	192.03	-0.85	5.62	8.69
42 RAILROADS (49)	100.00	108.67	134.30	160.11	1.66	2.65	4.84
43 AIR TRANSPORT (52)	100.00	95.56	120.25	142.79	-0.91	2.87	5.02
44 TRUCKING,OTH TRANS(50-51,53-54)	100.00	103.28	122.28	144.52	0.64	2.11	4.20
45 COMMUNICATIONS SERVICES (55)	100.00	109.87	142.72	201.86	1.88	3.27	7.60
46 ELECTRIC UTILITIES (56)	100.00	99.39	116.97	137.65	-0.12	2.04	4.07
47 GAS,WATER & SANITATION (57,58)	100.00	90.03	89.52	89.75	-2.10	-0.07	-0.04
48 WHOLESALF & RETAIL TRADE (59,60)	100.00	97.01	101.10	104.91	-0.61	0.52	0.98
49 FINANCE & INSURANCE (62)	100.00	99.90	104.72	109.77	-0.02	0.59	1.18
50 REAL ESTATE (63)	100.00	82.75	91.50	95.87	-3.79	1.26	1.84
51 HOTELS; REPAIRS EXC.AUTO (65)	100.00	92.86	92.21	92.52	-1.48	-0.09	-0.05
52 BUSINESS SERVICES (66)	100.00	88.46	90.68	92.95	-2.45	0.31	0.62
53 AUTO REPAIR (67)	100.00	90.90	90.17	90.54	-1.91	-0.10	-0.05
54 MOVIES & AMUSEMENTS (68)	100.00	99.38	103.12	103.62	-0.12	0.46	0.52
55 MEDICINE, EDUC, NPO (69)	100.00	95.91	95.37	95.64	-0.84	-0.07	-0.03
GNP / CIVILIAN JOBS	20363.69	20120.22	21744.09	23177.36	-0.24	0.97	1.77
(GNP-GOVT) / PRIVATE JOBS	18538.61	18202.75	19919.82	21567.23	-0.37	1.13	2.12

Mr. **Gephardt**. Thank you for excellent testimony.

Our next speaker is Marc Bendick, Director for the Program on Economic Change and the American Work Force with the Urban Institute.

[The biograhpical sketch of Dr. Bendick follows:]

THE URBAN INSTITUTE 2100 M STREET, N.W. WASHINGTON, D.C. 20037

MARC BENDICK, JR.

Marc Bendick, Jr., is an economist with wide-ranging interests in issues of employment, human resources development, economic development, and the efficient delivery of human service programs. He is an experienced policy analyst and researcher, writer and speaker, program manager, and consultant to the public and private sectors.

Since 1975, Mr. Bendick has been affiliated with The Urban Institute, one of the United States' major centers for nonpartisan research and innovative thinking on social and economic issues. As a senior research associate, he has performed and directed needs assessment, program evaluation, and policy analysis studies on such topics as low-income community revitalization, industrial policy, management reform of the nation's public welfare system, enhanced job opportunities for the hard-to-employ, and public-private cooperation in social problem-solving. In 1981, he was selected to direct a special Urban Institute program on structural change in the American economy and the re-employment of dislocated workers.

Mr. Bendick is a Phi Beta Kappa graduate of the University of California, Berkeley, and holds a doctorate in economics from the University of Wisconsin. Prior to joining the Urban Institute, he worked in corporate planning at the McDonnell Douglas Corporation and in urban redevelopment at the Nika Corporation. His writings include more than fifty books, monographs, and articles in professional journals.

Dr. **Bendick**. Thank you, Mr. Chairman.

I appreciate the opportunity to participate in these hearings on the implications of new technology for employment in the United States. I am Dr. Marc Bendick, Jr., an economist with the Urban Institute, which is a nonprofit public policy research center in Washington, D.C. I have devoted the past 3 years to examining the unemployment problems of workers laid off from America's so-called declining industries, the ways in which these workers make their transitions to new employment, and the roles which Government can most usefully undertake in directing and speeding these transitions. These are the subjects which I will address today, particularly in relation to "new technology" as a source of change in our economy but also in relation to changes in the structure of the economy more generally.

I will begin by recalling to your minds an image which the news media flashed across the Nation on April 6 of this year. On that day, President Reagan traveled to Pittsburgh to visit a CETA-funded training center where 100 unemployed steelworkers are being retrained as computer repair technicians. Through extensive newspaper and television coverage, the Nation looked over the President's shoulder at what was purported to be the future world of American employment—a world where U.S. manufacturing jobs will have virtually disappeared under the combined onslaught of robot efficiency and cheap foreign labor; where every American worker is a highly skilled technician engaged in an occupation not even imagined a generation before; and where intensive midcareer retraining not provided by employers will be required by millions of American workers caught in this overnight industrial revolution.

I want you to fix this image firmly in your minds—and then wash your minds out with soap. For this is a seriously misleading image of the American economic present and the near-term American economic future. If it dominates our thinking about the problems of the labor force today, we will mislead individual workers in their career decisions, misspend scarce public employment and training resources, and retard rather than promote the growth and international competitiveness of the American economy.

Because time is brief, I will not attempt to describe the changing employment picture in the United States to its full complexity. Instead, let me simply bring to your attention several facts not widely recognized in recent discussions of worker dislocation and unemployment. These facts will, I hope, convince you that the U.S. economy is engaged not in a disruptive and threatening second industrial revolution but rather in a generally tranquil and, in the long run, beneficent, industrial evolution. The appropriate role for government in this evolutionary change is quite different from that implied by the image of the President's visit to Pittsburgh.

Reading the popular press, one is led to believe that worker dislocation—in the sense of the permanent disappearance of jobs from which workers are laid off—is epidemic in the American labor force. There is no doubt that in specific labor markets undergoing large-scale, permanent plant shrinkages or shutdowns, there are local epidemics of such permanent dislocation. These are occurring predominantly in a limited number of specific communities in the manufacturing Frost Belt, such as Detroit, Youngstown, Flint, Buffalo, and Pittsburgh, and are heavily concentrated in a few industries. The names "auto" and "steel" come up over and over again. Nationwide, my own estimates are there are approximately 100,000 workers who are currently unemployed, whose old jobs have permanently disappeared, and who have not been readily absorbed by other job openings.

But these 100,000 dislocated workers comprise only 1 or 2 percent of the Nation's more than 11 million current unemployed. They even account for only about 10 percent of the unemployed in their own industries. These cases of permanent changes in employment are occurring within a context of a very prolonged, deep recession, combined with what has been a sustained era of extraordinarily high interest rates; and it is these cyclical and macroeconomic factors which put the majority of these unemployed out on the streets. It is not structural factors such as new technology. When we pull our Nation back out of this recession, the majority of the unemployed will go back to the jobs and industries from which they came or to similar ones; and this is true even in manufacturing and even in the traditional industrial Frost Belt.

There are exceptions. Steel is one we have heard about this morning which is in long-term secular decline. Automobiles represent a second partial example. But I would like to directly differ from what Mr. Hirschhorn said earlier in his testimony. I don't think that those two industries, or that one and a half industries, are a harbinger of what is happening to the rest of the industries in the Nation. They should not be taken as a prototype for the problems and future growth of other industries.

We have heard a lot about the fact that manufacturing jobs are a declining proportion of all employment in the United States, but I think it is important to keep in mind that a declining proportion of jobs should not be confused with a declining number of jobs. Total American employment in manufacturing is held steady at about 25 million jobs for more than a decade and represents a declining proportion of all jobs only because the service sector has grown more rapidly in the same period.

Another well-publicized aspect of the manufacturing employment issue is, of course, robotics, or the replacement of relatively low-skilled mass production workers by smart machines. However, the most careful estimates of the total displacement likely to arise from this source are dramatic mostly, once again, in their smallness, not their largeness. The best available estimate is that no more than 20,000 workers in manufacturing will face displacement each year. That is 2 workers out of 1,000 among today's unemployed and 1 worker out of 1,000 among today's manufacturing work force.

Even in the automobile industry, where robot displacement is estimated to be the largest, it is projected that it will occur at the rate of only about 1 percent of the unskilled worker force or less per year. Given that voluntary turnover in manufacturing may run as high as 25 percent a year, such change can typically be handled by attrition rather than midcareer layoff.

My point is not, of course, that we have no unemployment problems. Rather, it is that rapid structural change in the economy, technological or otherwise, is not the dominant cause of the unemployment problems of today or the likely dominant problems of the next decade. Serious employment dislocation in midcareer workers is very real for certain individuals and certain communities, but it appears to be a problem of relatively limited magnitude and highly concentrated in time and space in a few dozen labor markets.

I would see this limited magnitude of the problem, about 100,000 workers per year, continuing to require assistance and services over the next several years. President Reagan in his budget proposals for 1984 has asked for $240 million in funding for title III of the Job Training Partnership Act, the titled designed to address the needs of dislocated workers. This level of funding is designed to support services for about 90,000 workers and therefore seems entirely appropriate both for next year and for the years following.

The next question then becomes: How do we spend that money wisely? Again, I would recall the image of President Reagan's visit to Pittsburgh where he observed steelworkers being retrained as computer workers. This image implies that the funds should be used to provide extensive and expensive training in new, high tech occupations. However, that is exactly the wrong approach, I would argue, for a number of reasons; and a number of other uses of the money make considerably more sense. I will briefly catalog for you what in my written testimony is spelled out in more detail in terms of some of these reasons and some of the alternative uses of the money.

The first reason that extensive Government investment in skill retraining is not the way to go is that the vast majority of new job openings which will be created in the American economy in the next decade are not in the glamorous new high tech occupations but rather in traditional occupations for which dislocated workers may already have requisite skills. The BLS projections have already been discussed and Ms. Vetter will tell you more about how to interpret them. But even taking account of some of the difficulties with those projections, I ask you to keep in mind the BLS projection of 500,000 truck drivers and 500,000 janitors over the next year compared to the estimate that the number of job openings to be created in all phases of robotics is less than 50,000.

A second reason for avoiding heavy Government investment and skill retraining is that those job openings which will be created by the newer, high tech industries do not necessarily require higher skill content than more traditional jobs. Indeed, in many cases, the growing sophistication of the machines with which employees are paired means that the skill level of the job itself can be reduced.

However, the most important reason for Government to avoid the role of mass skill retraining for dislocated workers is to be found by examining the training role of the private sector. The training function in American private industry is massive in scale. Currently, it is estimated at $50 million or so annually or about 10 times larger than the entire Job Training Partnership Act. Yesterday's secretary becomes today's word processor not by a firm laying off armies of obsolete secretaries and hiring other trained individuals. Rather, the firms send their own current secretaries to training. In parallel fashion, when firms expand their labor force, they often hire large numbers of unskilled workers and train them for their specific requirements.

However, a job seeker will be left behind in this uptake if he is not an attractive trainee. That, in fact, is a key problem for many of these 100,000 dislocated workers. About one-third of them do not possess a high school diploma and another one-third possess a diploma but cannot read or write at the skill level promised by that credential. If the Federal Government wants to utilize its modest scale training resources wisely, it will concentrate on this problem of functional illiteracy, on providing the prerequisites for skill retraining, rather than on skill training itself. That way, public moneys will complement rather than substitute for the large volume of private industry skill training available for training ready individuals.

At the same time, the Federal Government should, I believe, act to raise the level of investment by American industry in their retraining of their current work force. A minute ago, I talked about the huge magnitude of expenditures, $50 million a year, which private firms currently provide for training. As large as that number is, for a number of reasons spelled out in my written statement, the American private sector, acting alone, actually underinvests in the skills needed by its own work force.

In my written testimony, I commend to your attention the innovative system in operation in France since 1971 under which a payroll tax is utilized to impose a training obligation on all French firms, to get them working collectively to raise the skill level and modernize the skills of the entire French work force. Such a system could be adopted in the United States, either directly or through incremental strategies such as reprograming some of the payroll funds already collected for unemployment insurance.

In my written testimony, I also commend to your attention various programs for training dislocated workers in how to seek reemployment efficiently. Such programs are one very useful way to expend funds available under the Job Training Partnership Act's title III.

Finally, I would commend to your attention some techniques the Government can use to address the problems of the clustering of dislocated workers in time and space which I have also previously mentioned. However gradual the pace of economic change may be when viewed from a national perspective, change actually proceeds by specific plant shutdowns in specific labor markets. At the local level, each such event is a major disaster. When that disaster strikes, local adjustment resources become swamped.

I would, therefore, propose one of the uses of title III resources from the Job Training Partnership Act would be to finance a special institution to provide large-scale, rapid, flexible but short-term (6- to 9-month) assistance in these crisis locales. In my written testimony, I suggest ways in which such an institution might be modeled on an innovative Canadian Government agency called the Canadian Manpower Consultative Service.

Thank you very much.

Mr. **Gephardt**. Thank you very much for excellent testimony, both written and oral.

[The prepared statement of Dr. Bendick follows:]

GOVERNMENT'S ROLE IN THE JOB TRANSITIONS OF AMERICA'S DISLOCATED WORKERS

by
Marc Bendick, Jr.

A Statement before the Committee on
Science and Technology
and the Committee on the Budget,
U.S. House of Representatives

Hearings on Technology and Employment
June 9, 1983

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Mr. Chairman and Members of the Committee:

I appreciate the opportunity to participate in these hearings on the implications of new technology for employment in the United States. I am Dr. Marc Bendick, Jr., an economist with the Urban Institute, which is a nonprofit public policy research center in Washington, D.C.[1] I have devoted the past three years to examining the unemployment problems of workers laid off from America's so-called declining industries, the ways in which these workers make their transitions to new employment, and the roles which government can most usefully undertake in directing and speeding these transitions. These are the subjects which I will address today, particularly in relation to "new technology" as a source of change in our economy but also in relation to changes in the structure of the economy more generally.

I will begin by recalling to your minds an image which the news media flashed across the nation on April 6 of this year. On that day, President Reagan travelled to Pittsburgh to visit a CETA-funded training center where one hundred unemployed steel workers are being retrained as computer repair technicians. Through extensive newspaper and television coverage, the nation looked over the President's shoulder at what was purported to be the future world of American employment--a world where United States manufacturing jobs will have virtually disappeared under the combined onslaught of robot efficiency and cheap foreign labor; where every American worker is a highly-skilled technician engaged in an occupation not even imagined a generation before; and where intensive mid-career retraining not provided by employers will be required by millions of American workers caught in this overnight industrial revolution.[2] I want you to fix this image firmly in your minds--and then wash your minds out with soap. For this is a seriously misleading image of the American economic present and the near-term American economic future. If it dominates our thinking about the problems of the labor force today, we will mislead individual workers in their career decisions, misspend scarce public employment and training resources, and retard rather than promote the growth and international competitiveness of the American economy.

Because time is brief, I will not attempt to describe the changing employment picture in the United States in its full complexity.[3] Instead, let me simply bring to your attention several facts not widely recognized in recent discussions of worker dislocation and unemployment. These facts will, I hope, convince you that the United States economy is engaged not in a disruptive and threatening "second industrial revolution" but rather in a generally tranquil and, in the long run, beneficient, industrial evolution. The appropriate role for government in this evolutionary change is quite different from that implied by the image of the President's visit to Pittsburgh.

Some Facts about the Role of Manufacturing in the American Economy

Reading the popular press, one is led to believe that worker dislocation--in the sense of the permanent disappearance of jobs from which workers are laid off--is epidemic in the American labor force. There is no doubt that in specific labor markets undergoing large-scale, permanent plant shrinkages or shutdowns--there are local epidemics of such permanent dislocation. These are occurring predominantly in a limited number of specific communities in the manufacturing frostbelt, such as Detroit, Youngstown, Flint, and Buffalo. Nationwide, my own estimates are that there are approximately one hundred thousand workers who are currently unemployed, whose old jobs have permanently disappeared, and who have not been readily absorbed by other job openings.[4]

But this one hundred thousand dislocated workers comprise only one or two percent of the nation's more than eleven million current unemployed. They even account for only about 10 percent of the total unemployed in their own industries and occupations. These cases of permanent changes in employment are occurring within a context of a very prolonged, very deep recession in the economy, combined with a sustained era of extraordinarily high interest rates. It is these cyclical macroeconomic factors--recession and high interest rates--which have put the majority--five or six million--of the eleven million unemployed out on the streets; it is not structural factors such as new technology or changing patterns of international trade. And when, slowly and painfully, we pull our national economy back out of this recession, the majority of the unemployed will go back to the jobs and the industries from which they came, or to very similar ones. This is predominantly true even in manufacturing and even in the traditional industrial frostbelt.

Those workers who will be left behind by an economic recovery, if government fails to act, will include many of those 100,000 or so dislocated workers. But they will be dominated by some four or five million disadvantaged workers--inner city, minority, teenage high school dropouts; women dependent on public assistance; low-skill, low-wage "working poor" adults; and other, similar groups in the labor market. Government has been seeking to address the employment problems of these groups for some twenty years now, through programs such as the Job Corps, the WIN program in AFDC, CETA-financed training and work experience, and, starting October 1, Title II of the Job Training Partnership Act (JTPA). The needs of these groups remain, and continued and expanded financial support of these public programs should remain a national priority.[5]

My optimistic conclusion with respect to the limited number of dislocated workers may seem at first implausible to you in light of some very widely publicized assertions about the American economy--namely, that dislocated workers number in the millions; and that the reason for that is that manufacturing jobs are a declining proportion of all employment in the United States. But cyclically unemployed workers should not be confused with structurally dislocated workers; and a declining proportion of jobs in manufacturing should not be confused with a declining number of jobs. Total American employment in manufacturing has held steady at about 25 million jobs for more than a decade; it has only represented a declining proportion of all jobs because the service sector has grown dramatically in the same period (from some 47 million jobs to 65 million jobs).[6] Recent statistical estimates suggest that this steadiness in the total number of manufacturing jobs which would be available in a nonrecessionary economy has continued even in the midst of the current recession.[7]

Of course, within this steady total number of manufacturing jobs, there is constant change. Certain individual plants, firms, and product lines close, while others open. That turnover creates local pockets of displaced workers--those whose particular job has disappeared and who must become reemployed elsewhere. But since the total number of manufacturing jobs is not declining, there should be no presumption that the majority of workers dislocated from manufacturing jobs must shift their career dramatically and seek reemployment outside of manufacturing.

Nor, indeed, is there a strong factual basis for a presumption that an individual unemployed from a declining industry--manufacturing or otherwise--will experience greater reemployment difficulties than an otherwise similar unemployed individual from a stable or growing industry. My own empirical research failed to indicate that the long-term employment trends of an industry or occupation *per se* made much difference in how fast a worker became reemployed.[8] This sort of finding suggests that the category of "dislocated worker" itself may not be the most useful way to identify a worker in need of government assistance. Consistent with that notion, it is useful to recall the experience of the Trade Adjustment Assistance Program, which provided special benefits to workers who had "permanently" lost their jobs under the pressure of increased foreign competition. At one point, it was estimated that seventy percent of the benefits under this program went to workers who subsequently returned to the very same employers from whom they were supposedly permanently displaced.[9]

One particularly well-publicized aspect of the manufacturing employment issue is that of robotics, the replacement of relatively low-skilled mass production workers by "smart machines." Certainly the technological advances in this field are noteworthy, with a projected 30 to 40 percent annual growth for the robot population engaged in manufacturing.[10]

However, careful estimates of the total job displacement likely to arise from this source are dramatic largely in their smallness, not their largeness. The best available estimate, that provided by researchers at the W. E. Upjohn Institute for Employment Research, is that robots will directly substitute for between 100,000 and 200,000 workers over the decade of the 1980s. Taking the larger of these two figures, this estimate implies that 20,000 workers in manufacturing will face displacement each year -- two workers out of 10,000 in the total U.S. work force, two workers out of 1,000 among today's unemployed, and one worker out of 1,000 among today's manufacturing work force. These figures imply that no robot population explosion should be blamed as the primary source of today's massive unemployment; and they imply that planning for massive job displacement in the face of a robot population explosion would be an inappropriate national priority in the next decade.

Again, of course, there are individual workers who face readjustment problems because their jobs have been robotized. An there is at least one industry, according to the Upjohn Institute, where the displacement effect will be significant. This is the automobile industry, where between six and eleven percent of all operative and laborer jobs will be displaced by 1990. But even in this industry of the greatest impact, this projected displacement is only at the rate of one percent of the unskilled worker force or less per year. Given that typical voluntary turnover in manufacturing jobs may run as high as 20 or 25 percent a year, such displacment can typically be handled by attrition rather than layoff.[11]

A second source of concern over massive job displacement in American industry is that of the "export" of American manufacturing jobs to foreign countries with lower wage levels. It is clear that very high union wage scales -- sometimes more than $20 per hour in total compensation costs for workers with few special skills -- have contributed to the rapid loss of U.S. market shares in such industries as automobile manufacturing and basic metals production. But the picture in U.S. manufacturing more broadly is far less dramatic.

First, labor costs in much of U.S. manufacturing have not risen to levels which create extreme economic pressure to move jobs abroad or which create inordinate profit opportunities for foreign competitors. In fact, one of the major barriers to employment adjustment by workers laid off from industries such as automobile manufacturing is that alternative manufacturing jobs open to them in the United States often pay less than half their previous wage.[12] The increasing involvement of the U.S. economy in international markets will certainly exercise a competitive descipline on U.S. wage levels, to keep them reasonably related to worker productivity. But that international competition will not necessarily lead to massive job dislocation because most U.S. wage levels do not seem extraordinarily out of line.

The second reason that the so-called export of jobs need not be viewed with alarm is that this process has been going on for many decades and for thousands of products in harmony with a growing and prosperous American economy. Indeed, it is one of the wellsprings of that prosperity, as the rising incomes of America's trading partners create expanding markets for U.S. products.

Economists have recognized for more than twenty years that individual manufacturing products tend to pass through a "life cycle" over time and that "export" of manufacturing production is a common and efficient later phase of that cycle.[13] In the early years of a product's lifetime, when the product is being designed, developed, modified, and introduced to its market, the work required on the product is largely nonstandard and skill-intensive. It is therefore efficient to perform this work with a comparatively high-skill, high-wage work force such as is found in the United States. Once the product has become standardized and when a mass market has been developed, competition in the product focuses more and more on the costs of production; and these costs can often be reduced by shifting the work to a lower-wage, lower-skill labor force, often in a newly industrializing nation such as Taiwan or Singapore.

The American economy has experienced this cycle over and over, for thousands of products and millions of jobs, over many decades. Today the product involved may be basic steel--or Atari computers; a decade ago, it was consumer electronics; and several decades before that, it was shoes and textile gray goods. The movement overseas of the production of a particular product is not fatal to the American economy or the living standards of the American work force, as evidenced by the fact that the decades which have seen this movement have also seen prosperity, rising living standards, and a rapid expansion of the American work force. If the wellsprings of research, development, and innovation generating new products at the "front end" of their life cycles were to dry up, then the American economy would be in trouble; but trouble is not signaled by the "graduation" of products in the latter stages of their cycles, even products which have become a familiar part of the American economic landscape.[14]

Defining the Dislocated Worker Problem

The message of this upbeat discussion of the American economy, of course, is not that we have no unemployment problems. More than eleven million unemployed workers testify clearly that this is not so. Rather, my point is that we must not accurately understand the nature of that unemployment if we are to address it effectively. There is little evidence which suggests that rapid structural change in the economy, technological or otherwise, is the root cause of the majority of the unemployment problems of today. Those problems are predominantly cyclical;[15] and, to the extent that they are structural, primarily involve disadvantaged workers rather than dislocated ones. There is little evidence which suggests that rapid structural change in the economy threatens us with massive employment dislocation over the next decade. Serious employment dislocation of midcareer workers appears to be a problem of relatively limited magnitude--I have already mentioned 100,000 workers among the current unemployed as my own empirical estimate--and highly concentrated in time and space in a few dozen labor markets such as Detroit, Pittsburgh, Buffalo, Youngstown, and Flint.

I would see this magnitude of the problem--about 100,000 workers per year --requiring service over the indefinite future. Individual workers will, of course, not remain in that population for multiple years; but a constant flow of plant closures and other dislocations will repeatedly generate that number of new workers needing assistance. In his budget proposals for Fiscal Year 1984, President Reagan has asked for $240 million in funds for Title III of the Job Training Partnership Act, the title addressing the needs of dislocated workers. This level of funding is designed to support services to about 90,000 workers. In light of my estimates of the size of the dislocated workers problem, I would conclude that this order of magnitude of funding seems appropriate both for next year and for the years following.

Public Funding of Skill Retraining for Dislocated Workers is Not the Answer

The key question then becomes: How do we spend this money wisely? Again I would like to recall the image of President Reagan's visit to Pittsburgh, where he observed steelworkers being retrained as computer technicians. This image implies that the funds should be used to provide extensive retraining in specific occupational skills in new, "high tech" occupations. This approach is inappropriate for a number of reasons.

The first reason is that the vast majority of new job openings which will be created by the American economy in the next decade are not in glamorous new "high tech" occupations but rather are in traditional occupations for which workers displaced from declining industries may already have the requisite skills. The U.S Bureau of Labor Statistics projects, for example, that between 1980 and 1990, there will be 700,000 new job openings for secretaries; 500,000 openings for truck drivers; 500,000 for nurses' aides; and 500,000 for janitors.[16] In the same era, according to the Upjohn Institute study cited earlier, the number of job openings created in all phases of the robotics industry--design, manufacturing, operations, and maintenance--will be between 30,000 and 60,000.[17] New, high tech occupations may have spectacularly high percentage growth rates--the population of robotics technicians may be growing at 500 percent per year--but the total number of jobs is very small, compared to the numbers available in traditional fields.

The second reason for approaching suggestions for massive government investment in skill retraining with skepticism is that those job openings which will be created by the newer, high tech industries do not necessarily require higher skill content than more traditional jobs; indeed, in many cases, the growing sophistication of the machines with which employees are paired means that the skill level of the job itself can be reduced.[18] Consider, for example, the role of the maintenance worker charged with keeping an assembly line robot in operation. When an arm of that robot ceases to function, the maintenance worker does not halt the assembly line and skillfully diagnose and repair the problems of the arm. Rather, he simply replaces the arm module with a new one and probably discards rather than repairs the malfunctioning one. A similar example is provided by word processing machines which now can correct the spelling of badly trained typists.

The third, and perhaps the most important, reason for government to avoid the role of mass skill retraining for dislocated workers is to be found by examining the training role of private employers in the absence of government action. The training function in American private industry is massive in scale, currently estimated at some $30 to $50 billion in expenditures annually,[19] or some ten times larger than the scale of the entire Job Training Partnership Act. Businesses train and retrain workers all the time, as part of their routine costs of doing business. They provide training to keep employee skills up to date, to provide upward mobility, and to permit lateral changes as products and production processes change. Yesterday's secretary becomes today's word processing technician not by firms' laying off armies of obsolete secretaries and hiring different individuals who arrive with word processing skills; rather, they send their current secretaries to a week's training, and then the secretaries obtain further practice on the job. Similarly, newly-created robot maintenance jobs on auto assembly lines are being filled primarily by modest, company-provides retraining for employees who already were at work in the plant as electricians or millwrights.

In parallel fashion, when firm expands their labor force, they often hire large numbers of raw trainees and then train them for their specific requirements. This process creates many opportunities for reemployment of dislocated workers without specific job skills. However, a jobseeker will often be left behind in this uptake if he is not an attractive trainee; and, all too often, that is a key problem for many dislocated workers. My own empirical research on dislocated workers nationwide suggested that about one-third do not possess a high school diploma, and perhaps another one-third possess a diploma but cannot read, write, compute, or reason at the skill level promised by that credential.[20] Functional illiterates do not make safe, flexible, productive, or easily-trained employees; that, rather, than their lack of specific job skills, is what screens them out of job opportunities.

If the federal government wishes to utilize its modest-scale training resources wisely, it will concentrate on this problem of functional illiteracy--on providing the prerequisites for skill training--rather than on skill training itself. Thay way, public monies will complement, rather than substitute for, the large volume of private industry skill training available to training-ready individuals. To achieve this end, I would propose a new public program which would offer to every unemployed individual who cannot currently function at the skill level of a high school graduate the opportunity to acquire these skills (and to acquire a high school diploma if he does not already possess one). This offer should, I believe, include two elements:

- o The availability of an adult school--tuition free, locationally accessible, and designed to serve midcareer adults who are often not comfortable in a traditional classroom setting,[21] and
- o an income maintenance stipend, at the level offered by unemployment compensation, while receiving this training.

I also believe that it makes sense to extend this offer to all unemployed persons, regardless of whether they are dislocated from a declining industry or are unemployed from some other background (although, as I have just said, a great many dislocated workers will readily qualify).

A second useful role for the federal government to undertake in relation to worker retraining would be to revise several anachronistic federal policies which set up barriers to individual workers' investment in their own retraining. The federal income tax, for example, allows an individual to deduct educational expenses if they are related to maintaining his skills in his current occupation but not if they prepare him for a new occupation.

Similarly, in all states of the nation except California, unemployment compensation is available only to those workers who are "available for work," and a person enrolled in full-time training is judged not available. An unemployed individual interested in training for a new occupation either must wait until his employment compensation eligibility is exhausted, or he must give up the wage replacement income on which he is depending. Understandably, this situation reduces or delays the participation of many workers in retraining.

Persuading the Private Sector to Invest More in Training Their Current Employees[22]

Finally, the federal government, I believe, should act to raise the level of investment by American industry in retraining their current workforce. A few minutes ago, I was emphasizing to you the huge magnitude of expenditures--perhaps $50 billion per year--which private firms currently expend on training. Large as this number is, there is reason to believe that it is still less than the socially optimal level of investment for the American economy and the American people. Due to the presence of what economists refer to as "private market failures," the American private sector acting alone persistently underinvests in the skills needed by its own work force. These market failures hamper both investment by employers in training their current employers and employees' investment in training themselves.

In the case of employers, investment in worker training, like any other investment decision, is decided upon in terms that return on this investment. When workers are free to move from company to company, it is risky for an employer to spend thousands and thousands of dollars to give a worker a skill in great demand, because that firm's competitor will try to hire that worker away the minute his training is complete. When all employers together react to this fact, we get a situation where everyone needs a skilled labor pool but nobody will pay for it.

As for employees, we do see a great deal of self-investment by workers. When a high school graduate goes to college, or when you or I take a job despite a low wage but "because it is good experience," that is precisely what is going on. But in an era of rapid economic and technological change, more and more workers are faced with the need to make a major investment in their own retraining at midcareer. Such bouts of midcareer formal training are difficult for workers to finance. First, they require quite a cash flow, both to pay for the instruction itself and to support the worker and his or her family while the training is proceeding. This can be a particular problem if the worker wishes to undertake retraining when unemployed, when cash flow is tightest. Second, because formal midcareer training is very expensive, individuals may be reluctant to undertake such a sizeable investment when there is no certainty that it will pay off. And finally, there is a problem of information: Individuals may not be well enough informed about trends in the labor market to pick the right field in which to be trained.

The training gap between what the private sector is currently providing and the ever-increasing training needs of society can be effectively addressed by a new federal initiative. A model for this federal action can be found in the French experience. Since 1971, the French have operated a national system for financing worker training which creates an effective public-private partnership to address exactly the problems outlined.

The key element of the system is what the French refer to as an "obligation to spend," enforced by a payroll tax if that obligation is not met.

Each employer of ten or more employees has, by law, an obligation to expend an amount equal to 1.6 of its total wage bill to maintaining and expanding the skill level of the French labor force. If the firm chooses to train its own workers and spends at least the 1.6 percent minimum, then its obligations are discharged. Or the firm may meet the requirement by participating in and financially supporting an industry-wide training fund (usually operated cooperatively between employers' associations and trade unions). Or the firm may donate the funds to a government training center. But the firm might as well spend on one of these forms of training, because if it fails to meet its obligations to spend, then the unspent balance of the 1.6 percent is due to the government as a payroll tax.

One of the advantages of such an approach is its flexibility and decentralization of decisionmaking. Funds may be used for preventative training (to avoid layoffs by retraining workers for new products and processes), for the training of newly hired workers (including apprentices), for occupational advancement of workers, for the maintenance of old skills, or the acquisition of new ones. No vast amounts of money flow into and out of the public treasury, and no government central plans or decisions constrain what a firm may do. Yet each firm has a profit incentive to use its training resources wisely, and all firms together are required to maintain a high level of sustained investment in the French workforce.

Such a system could be adapted in the United States, either directly or through one of several incremental strategies. One of the incremental strategies would involve reprogramming for training purposes some of the payroll tax fund already collected for unemployment insurance. The state of California has taken a step in this direction by reducing its payroll tax for unemployment insurance by one-tenth of one percent and creating a new payroll tax in the same amount for worker retraining and other adjustment programs. Another incremental approach would be to impose this obligation to train initially on the defense industry, where government purchases already create both a prosperous growth period and a basis for federal intervention. Chairman St. Germain of the House Banking Committee has recently introduced proposals to this effect in discussions of the proposed Defense Industrial Base Revitalization Act.

Whatever strategy might be adopted for implementing the approach, the idea should have a broad appeal to a variety of important constituencies. The leadership elements of the business community should be as enthusiastic about this approach in the United States as they are in France. After all, most major corporations already invest heavily in training. Their obligations under this system would typically be discharged by their current level of activity, while their less active competitors (who have been stealing their staff) would be forced to carry their fair share. At the same time, the leaders of labor should be enthusiastic about a system which assures a sustained level of resources to make workers participants in and beneficiaries of technological change. A higher level of general labor force training would prevent a good deal of worker dislocation by providing resources for in-house retraining as a substitute for dislocation, while currently-dislocated workers would be benefited by new entry-level employment slots which would be created as current employees move upward via training. Taxpayers stand to gain from reduced unemployment insurance and public assistance claims, and we all stand to gain from enhanced national productivity and international competitiveness.

Training Dislocated Workers in Job Search and Career Management

While publicly-provided skill training is, as I have emphasized, not a promising place for use of public resources in the reemployment of the majority of dislocated workers, assistance and training in the job search process probably is a useful public role. There is, of course, wide variation among dislocated workers, as in any large population, in the level of job search skills and resources which individuals possess. But a substantial proportion of such workers have, prior to becoming dislocated, enjoyed long tenure with one employer. Their job search skills, which may never have been extensive, are therefore often rusty from disuse. They have not, within recent memory, been faced with the challenges of writing a resume, presenting themselves in job interviews, thinking through the transferability of their past job skills to a different occupation or industry, or searching for jobs not publicly listed. Additionally, the experience of becoming unemployed after an extended period of job stability is emotionally traumatic for many workers, making various forms of encouragement potentially important in overcoming lethargy. Finally, a course, many dislocated workers become unemployed as part of plant closures or mass layoffs or in a locale of general economic decline. In such circumstances, run-of-the-mill types of job search approaches--such as asking friends and relatives or checking for postings at local plant gates--may be inadequate, whereas they might have sufficed in more favorable circumstances.

One currently-fashionable mode for providing transition services which addresses these problems is the "job club."[23] A job club is a temporary alliance of job seekers who meet regularly to provide aid and mutual reinforcement to each individual's job search.

The operating mode of a job club typically includes the following elements:

- A membership of no more than 25;
- Regular meetings for substantial amounts of time (e.g., half a day three times per week);
- Explicit training on specific job search and self-presentation skills (e.g., resume writing, interview techniques); extensive use of practical exercises and role-playing in this training;
- Provision of job search materials and facilities (newspaper want ads, telephones) for actual job-seeking during the meetings; and
- An atmosphere of peer pressure and support for a sustained level of search activity.

In short, the job club is a mechanism for encouraging and assisting individuals to work hard and effectively in making their own reemployment transitions; they do not operate on the principle of a formal labor market intermediary institution finding jobs for them.

Such an approach tends to be cost-effective both because it costs relatively little per client served (perhaps $700 or so) and because it provides only the relatively minimal level of transition assistance many dislocated workers require. Sponsorship of job clubs or similar relatively inexpensive job search assistance mechanisms is one useful way to expend funds to be made available under JTPA Title III. The Downriver Community Conference demonstration program, which for several years has been providing reemployment assistance to workers laid off from the Detroit-area automobile and autombile-related industries, offers one example of such services being skillfully and effectively provided.

While such assistance to pockets of dislocated workers will prove helpful in the short run, federal attention should also turn to the longer run question of how job vacancy information is processed in the American economy. The reemployment problems of dislocated workers and the challenge of structural change in the economy are not uniquely associated with this larger question, but they do raise the question with particular urgency. For, despite the fact that the 1980s is an era of an unprecedented revolution in information technology, the United States remains in the horse and buggy era in terms of the exchange of information concerning job opportunities and job seekers. For most persons looking for employment, the job search process is a hit or miss affair of asking friends or applying in person at local plant gates. At one step of greater sophistication, newspaper ads or employment agencies are consulted, although they offer information about only a fraction of vacancies. The federal-state employment service ("Job Service"), in operation since the 1930s, corners only a small fraction of the placement market, concentrates mostly on low skill or entry level jobs, and all too often offers only outdated or incomplete information on clumsy card files or microfiche systems.

Consider, in contrast, the situation in the nation of Sweden. There, a single nationwide computerized job file records every job vacancy in the nation. Employers are required to report all vacancies to the employment service (studies indicate that more than 90 percent of vacancies are actually reported); these vacancies are coded and entered into the system each evening; and the file can be searched by every employment service placement counselor in the nation through computer terminals in all local employment service offices. Sophisticated software allow file searching in a variety of different ways or at different levels of specificity. ("There are no openings for welders in Stockholm. Let's check the rest of the country, or let's check for jobs which require welding as a secondary skill.") It also allows a worker's credentials to be stored in the system to be tested against newly-listed vacancies each night, with the employment office automaticaly notified in the morning of a possible match.

There is no reason why the United States, the most computer-sophisticated nation on earth, could not implement an equally advanced system. We would probably structure it somewhat differently from the Swedes, of course, because of important differences between our two countries. For one thing, we might wish to develop a series of local-area job banks and/or occupationally-specific job banks, rather than a single nationwide job file for a labor market as big as the entire United States. Second, we might wish to provide a role for private employment agencies (which are illegal in Sweden) --perhaps as the "retail" point of client interface with the system. But federal leadership is essential to develop and operate the basic system itself, as a new, twenty-first century form of information public utility. Both employers seeking good employees and job seekings looking for opportunities stand to benefit. Dislocated workers would be one of many groups in the labor market who would particularly benefit.

A Federal Role in Providing Short-Term Assistance Teams for Communities Experiencing Large-Scale Employment Dislocation

One final useful form of federal action in addressing the problems of dislocated workers would involve taking explicit account of the clustering of dislocation problems in time and space which I have previously mentioned. However gradual and smooth the pace of economic change may be when viewed from a lofty national perspective, change actually proceeds by very specific plant shutdowns and mass layoffs in specific labor markets; and at the local level, each such event can be a major disaster.

When that disaster strikes, local adjustment resources become swamped. I would therefore propose that one use of resources under Title III of the Job Training Partnership Act would be to finance a special institution to provide large-scale, rapid, flexible, short term assistance in "crisis locales."

This institution might be modeled on an innovative Canadian government agency called the Manpower Consultative Service (MCS). The operations of the MCS can be briefly described as follows:[24]

- When a plant shutdown or mass layoff situation arises, the MCS becomes involved immediately and temporarily (e.g., for a six month to twelve month period). Thus, it supplements established local labor market institutions at a time of peak demand.
- MCS's major role is that of coordinating, facilitating, and encouraging the mobilization of local resources, primarily those of local employers and local unions, into a committee. It brings in a modest amount of matching funds for administrative expenses and the services of a case officer, but local government and private resources must also be contributed.
- All workers involved in the job reduction are contacted to see if employment assistance is desired. (Typically, 70 percent respond affirmatively.) Each individual expressing interest is then interviewed individually to determine the most appropriate form of assistance.
- Those workers who need or desire career counseling, training in job search skills, retraining, or relocation assistance are referred to the Canadian equivalent of the Job Service for such assistance.
- The major form of assistance provided to most workers--some 64 percent of all cases--is direct placement assistance. Here, the key role which the MCS and local committee play is to bring into the open jobs in the "hidden labor market" (i.e., those jobs which are typically filled by word of mouth).

As I would envision something like the MCS in operation in the United States, it would copy some aspects of the Canadian approach and modify others. For one thing, U.S. Job Service is not generally equipped to provide career counseling or training in job search skills. Therefore, an MCS-like agency would have to bring in the necessary skills and resources. Second, I would see an MCS-like intervention being triggered not only by a mass layoff or plant closing but also by long-term regional decline or persistent unemployment. Third, I would open these services to all persons in the labor force in a locale, not just those directly affected by a layoff; this is because all job seekers in a labor market have increased difficulty finding jobs following a layoff because of the increased competition from those laid off. Along with these modifications, however, I would preserve other aspects of the MCS approach: it role as a supplementer of existing services on a short-term basis, its tailoring of services of the needs of each individual worker, its nonbureaucratic style of operating, and its emphasis on mobilizing and enhancing local resources.

Conclusions

In conclusion, Mr. Chairman, I would like to summarize my message for federal policy in three key points.

- First, there is no reason to believe that technological change--or any other form of structural economic change--threatens the American labor force with a cataclysmic readjustment problem over the next decade; there is no basis for blaming the majority of our current unemployment problems on such change rather than on a terrible cyclical recession; and there is no reason to act to halt or slow the ongoing pace of change.
- Second, there is little basis for anticipating that the federal government will be required to spend billions of dollars on reemployment assistance to dislocated workers over the upcoming years. The number of such workers is probably on the order of 100,000 or so a year, not millions; funding of the Job Training Partnership Act's Title III at about $240 million per year seems approximately to cover the problem; and those funds should be spent primarily on relatively cheap and short term forms of assistance--such as job search training and short-term assistance to severely impacted communities, rather than on extensive and expensive worker skill training.
- Third, there is a role for federal leadership in reforming some basic institutions of the American labor market, to make that market function more smoothly and efficiently for dislocated workers and nondislocated workers alike. New incentives to raise the overall level of worker training by American industry--perhaps modeled on a French institution;

> new public job banks for computerized cataloging of job vacancies--perhaps modeled on a Swedish approach; new, flexible institutions for short-term assistance to local labor markets in distress--perhaps modeled on a Canadian idea; reforms of certain "anti-training" provisions of the federal income tax and unemployment insurance program; and establishment of a new effort to provide pre-training basic literary skills to the adult unemployed--these are the areas in which federal leadership and innovation are called for.

With such leadership and innovation, we may be confident that technological change, as well as other structural change in the American economy, will spell more employment, more prosperity, and more growth for the United States.

FOOTNOTES

[1] Opinions expressed in this statement are my own and do not necessarily reflect those of the National Commission for Employment Policy (which supported some of the research discussed herein), The Urban Institute, its trustees, or its other sponsors.

[2] Among recent writings in this tradition are Barry Bluestone and Bennett Harrison, The Deindustrialization of America (New York: Basic Books, 1982); Robert Ayres and Steve Miller, Robotics, Applications and Social Implications (Cambridge, Ma.: Ballinger, 1983); and Pat Choate, Retooling the American Work Force (Washington, D.C.: Northeast-Midwest Institute, 1982).

[3] For such broader discussions, see Isabel Sawhill, "Human Resources for the 1980s," in G. William Miller (ed.), The Regrowing of the American Economy (Englewood Cliffs, N.J.: Prentice Hall, forthcoming), and Martin Feldstein (ed.) The American Economy in Transition (Chicago: University of Chicago Press, 1980).

[4] See Marc Bendick, Jr., and Judith Radlinski Devine, "Workers Dislocated by Economic Change: Do They Need Federal Employment and Training Assistance?" in Seventh Annual Report: The Federal Interest in Employment and Training (Washington, D.C.: National Commission for Employment Policy, 1981), pp. 175-226.

[5] On the employment and training needs of the disadvantaged, see Marc Bendick, Jr., "Employment, Training, and Economic Development" in John Palmer and Isabel Sawhill (eds.) The Reagan Experiment (Washington, D.C.: The Urban Institute Press, 1982), pp. 247-270.

[6] See James Cook, "You Mean We've Been Speaking Prose All These Years?" Forbes, (April 11, 1983), pp. 142-148.

[7] See Isabel Sawhill, "Creating Jobs: Options for the 98th Congress," Testimony before the committee on the Budget, U.S. House of Representatives, Feburary 8, 1983, p. 7.

[8] See Bendick and Devine, op. cit., and Marc Bendick, Jr., "The Role of Public Programs and Private Markets in Reemployment Workers Dislocated by Economic Change," Policy Studies Review, forthcoming 1983.

[9] See Walter Corson et. al, Final Report, Survey of Trade Adjustment Recipients (Princeton, N.J.: Mathematica Policy Research, 1979).

[10] See H. Allen Hunt and Timothy L. Hunt, Human Resource Implications of Robotics (Kalamazoo, Michigan: W. E. Upjohn Institute for Employment Research, 1983).

[11] Use of attrition implies, of course, that the number of job openings available to new labor force entrants in these industries and occupations will be smaller than otherwise. Thus, the major focus of public efforts to train individuals for the occupations of the future and to draw them away from declining occupations should be on today's school age population, not on midcareer adults.

[12] For example, according to the U.S. Bureau of Labor Statistics (reporting in Employment and Earnings, May 1983), the average hourly wage in U.S. manufacturing was only $8.78 per hour. Primary metal production (including basic steel production) and transportation equipment manufacturing (including motor vehicle assembly) were each more than 30 percent above this average, but electronic equipment manufacturing was five percent below the average.

[13] See Raymond Vernon," International Investment and International Trade in the Product Cycle," Quarterly Journal of Economics (May 1966), pp. 190-207.

[14] However, the speed with which a product moves through this life cycle is very often open to influence by corporate management. Investment in modernizing the technology of U.S. plants will tend to keep production in the United States longer. So will marketing strategies which emphasize continued innovation in response to specialized customer requirements rather than mass production of a standardized product.

[15] To say that they are cyclical, of course, is not to say that they should be ignored. Rather, they should be addressed--but by various programs for bridging workers' income gaps until their old jobs return rather than by assistance designed to transition these workers to new industries and occupations. Such bridging assistance might particularly focus on health insurance coverage and on continuity of mortgage payments; and it might include earning opportunities in countercyclical "soft public works" or public service employment programs. For some disucssion of these options, see Marc Bendick Jr., "Reemploying Dislocated Workers — Five Strategies for Pennsylvania," Testimony before the House of Representatives' Committee on Appropriation, Legislature of the Commonwealth of Pennsylvania, March 9, 1983.

[16] See Robert J. Samuelson "The Old Labor Force and the New Job Market," National Journal (Feburary 26, 1983), pp. 426-431, and A.F. Ehrbar, "Grasping the New Unemployment," Fortune (May 16, 1983), pp. 106-112.

[17] See Hunt and Hunt, op. cit.

[18] See Henry M. Levin and Russel W. Rumberger, The Educational Implications of High Technology (Stanford, California: Stanford University Institute for Research or Educational Finance and Governance, 1983).

[19] See Seymour Lusterman, Education in Industry (New York: The Conference Board, 1977).

[20] See Bendick and Devine, op. cit.

[21] Many midcareer blue collar workers have relatively little recent experience with being in a classroom, and they may never have been comfortable with a school setting even when young. Therefore, effective programs of midcareer retraining need to adopt special training techniques and to develop "nonschool-like" atmospheres to serve adult learners effectively. For some ideas on adapting to the learning needs of adult workers, see Marc Bendick Jr., "The Swedish 'Active Labor Market' Approach to Reemploying Workers Dislocated by Economic Change," Journal of Health and Human Resources Administration, forthcoming 1983.

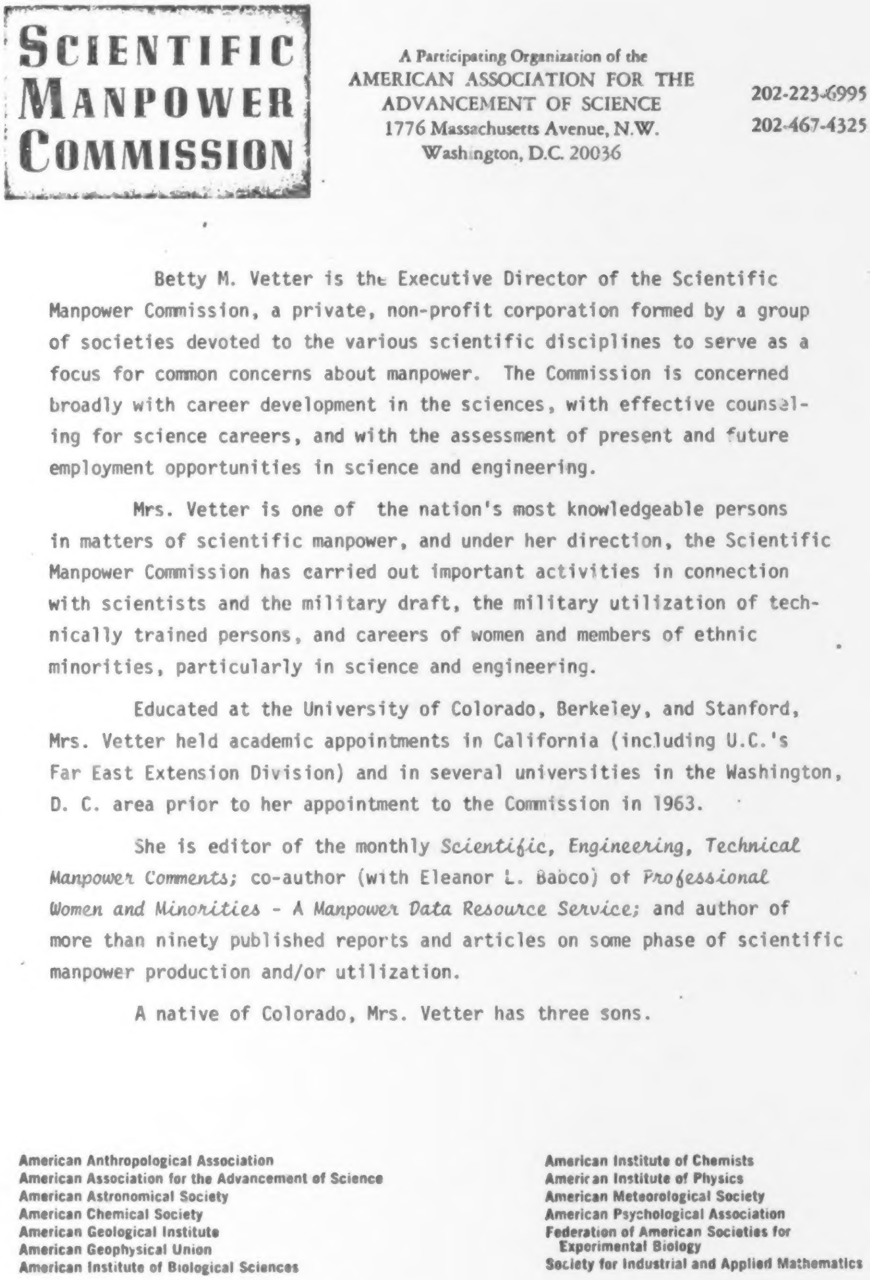
[22] For a more extensive version of this section, see Marc Bendick, Jr., and Mary Lou Egan, Recycling America's Workers: Public and Private Approaches to Midcareer Retraining. Washington, D.C.: The Urban Institute, 1982.

[23] On job clubs, see Marc Bendick, Jr., "The Role of Public Programs...," pp. 23-25.

[24] On the Canadian experience, see Michael C. Barth and Fritzie Reisner, Workers Adjustment to Plant Shutdowns and Mass Layoffs (Washington, D.C.: ICF, Inc., 1981), and Marc Bendick, Jr., "The Role of Public Programs...", pp. 26-27.

Mr. GEPHARDT. Our next speaker is Betty Vetter.

[The biographical sketch of Ms. Vetter follows:]



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Betty M. Vetter is the Executive Director of the Scientific Manpower Commission, a private, non-profit corporation formed by a group of societies devoted to the various scientific disciplines to serve as a focus for common concerns about manpower. The Commission is concerned broadly with career development in the sciences, with effective counseling for science careers, and with the assessment of present and future employment opportunities in science and engineering.

Mrs. Vetter is one of the nation's most knowledgeable persons in matters of scientific manpower, and under her direction, the Scientific Manpower Commission has carried out important activities in connection with scientists and the military draft, the military utilization of technically trained persons, and careers of women and members of ethnic minorities, particularly in science and engineering.

Educated at the University of Colorado, Berkeley, and Stanford, Mrs. Vetter held academic appointments in California (including U.C.'s Far East Extension Division) and in several universities in the Washington, D. C. area prior to her appointment to the Commission in 1963.

She is editor of the monthly *Scientific, Engineering, Technical Manpower Comments*; co-author (with Eleanor L. Babco) of *Professional Women and Minorities - A Manpower Data Resource Service*; and author of more than ninety published reports and articles on some phase of scientific manpower production and/or utilization.

A native of Colorado, Mrs. Vetter has three sons.

American Anthropological Association
American Association for the Advancement of Science
American Astronomical Society
American Chemical Society
American Geological Institute
American Geophysical Union
American Institute of Biological Sciences
American Institute of Chemists
American Institute of Physics
American Meteorological Society
American Psychological Association
Federation of American Societies for Experimental Biology
Society for Industrial and Applied Mathematics

Ms. **Vetter**. Mr. Chairman, I would like to start with the optimistic view. The revolution in technology is expected to create about 15 million new jobs by 1990 and they will run the gamut from the highly creative to the monotonously routine. These technologies will open up or expand new industries concerned with extending human capabilities in a variety of ways. These will create both professional and nonprofessional jobs, professional not only in technology itself, but also in sales, recruitment personnel management, training course development, teaching, advertising, and law, among others.

It will create even more jobs at the nonprofessional level.

In any one year, about 8 million people in the United States change jobs. Some unknown proportion of them change their occupation as well as their employer. Jobs opened up by these shifts plus those resulting from growth and replacement needs are expected to result in more than 23 million openings a year during the 1980's. Although many of the jobs will be associated in some way with new technology, most of them will not require persons with specific training in science or technology. Indeed, no high tech job even makes the Labor Department's list that has been mentioned two or three times this morning, the top 20 in terms of number of job openings, although there are several on the list of the top 20 in terms of fastest growth. I provided those to you in exhibit 2 (page 371).

Many will be in the clerical areas. Remember these are job changes as well as growths and replacements and in the service sector. But the number of jobs for technicians in such areas as energy and hazardous waste management, industrial laser processing, industrial robot production and maintenance, materials utilization, genetic engineering and computer-assisted design, graphics and manufacturing are expected to total between 4 and 5 million, and those numbers are in exhibit 3 (page 371).

BLS estimates projected openings for engineering and science technicians—reopenings and new jobs—of 168,000 to 183,000 a year to 1990. You will see those outlined in exhibit 4 (page 372).

For comparison, about 78,000, 2-year degrees were awarded last year in the natural sciences and engineering technologies. A shortage of technicians and skilled workers persists now in spite of record unemployment rates. Today's hard to find specialists include electronic and electrical technicians, numerically controlled machine maintenance and repair technicians, heating, ventilating, air conditioning technicians, as well as the traditional skilled production people such as machinists and tool and die makers. Those present shortages vary by specialty and by geographic region, and so will they in the future.

How good are the projections? Well, imperfect certainly, because they depend on assumptions regarding the state of the economy, the choice students will make, the way manufacturers will be able to sell products overseas, and a whole lot of other things. The changed method of estimating job openings by the Bureau of Labor Statistics, which has just gone in and which I think is confusing a lot of us, now includes both openings resulting from growth and from death and retirement, which the projections have always done, and adds, in addition, those that will result from job switching and from people entering or leaving the work force temporarily.

These numbers have greatly enlarged the projected numbers of jobs, and so that you can see some of that, I have shown you in exhibit 4 the average annual openings for a number of jobs as projected in 1980 by BLS, and then under the new system, as projected in 1982 as average annual openings from now to 1990.

For engineers, for example, the number of average annual openings forecast in 1980 were 46,500 a year. In the new projections, they are between 120,000 and 134,000 a year, but that includes all the job changers. This makes the job outlook for engineers very much different and indicates significant shortages of engineers compared with the relative balance forecast just 2 years earlier and assuming the same average number of bachelor's graduates forecast at that time, which was about 81,500 a year, a number incidentally we never have reached.

It is well above either our present production level or present production capacity given the shortage of qualified faculty.

We can't tell how many of these openings will be filled by the same individuals who are just transferring between employers. Equally large changes occur in the projections for technicians, computer programers, systems analysts, and others. You can see some of those in exhibit 5 (page 373).

The outlook for a supply-demand balance for technicians is particularly gloomy. To train tomorrow's technicians and even today's, more than two-thirds of employment managers polled recently favored converting the existing 2-year community colleges into advanced technical training schools wherever feasible. Most of the 2-year schools are not doing sufficiently sophisticated training now to meet industry's needs, and many doubt their ability to do so in the future.

Such a change would require many other things as well. Principally, raising the quality of the high school graduates preparing to enter such programs. This in turn requires increasing both the number and the quality of high school science and math teachers, the requirements for graduation, and for college entry for 2-year as well as 4-year and other graduate programs.

It means changing the course-taking habits of secondary students, and all the other factors that are contributing to the present crisis in precollege education, some of which are outlined in a supplemental paper that I submitted with this.

We can raise the requirements for graduation and college entry as is already beginning to occur, but without sufficient numbers of well-trained dedicated teachers, real change will not occur. Teachers, too, must have access to and training in the use of technology in their teaching programs if we are ever to overcome the deficit in educational programs. Top quality teachers also will be needed to man these new junior/community colleges turned technical institutes. We don't have them either.

Although the numbers pale in comparison with the probable number of jobs for technicians, we also have to continue to produce a sufficient number of engineers and scientists to teach, design, and carry out the research required to further develop and make full use of tomorrow's technology. Developmental specialists are required to insure that the results of this research are commercially developed in the United States rather than overseas as has been the case for so many things lately.

It takes 20 years to produce a qualified scientist or engineer, of which the first 10 to 12 years of training are crucial. If our public schools cannot attract and hold students in the sciences, then the numbers will continue to drop off, and it is important to look at some of those numbers. The number of bachelor's graduates in science, math, computer science, and engineering dropped 6 percent between 1974 and 1981, despite a 15 percent increase in the number of women earning these degrees and a 52-percent increase in the number of engineering degrees awarded.

At the doctoral level, science and engineering degrees dropped by more than 9 percent from 1971 to 1982, but the change resulted from a 22-percent drop in men, and a 108-percent increase in the number awarded to women. We also had among these degree recipients, a 112-percent increase in the number of foreign nationals who were here on temporary visas. So the drop in the number of U.S. males is even larger than it appears.

These decreases in science and engineering degree awards occurred while the college age population was still on a steep upward climb. We head into the next decade with a declining college age population which will drop 26 percent by 1992, with a well-documented drop in both the quality and quantity of precollege science and math education, and with severe shortages of qualified high school science and math teachers as well as engineering and computer science faculty.

I bring up the increasing participation of women in these fields because I think we cannot remain competitive in the increasingly technological world unless we do more rather than less to encourage the training and utilization in these fields of the female half of our population.

You are already familiar with the comparative data in training in those countries with whom we are in competition, both friendly and otherwise. Many of them are detailed for your reference in the supplemental paper.

Not only are we producing far fewer scientists and engineers per capita than other countries, but as the standard measures of academic performance show, our educational system is producing fewer and fewer able students in all fields. Although high technology will result in the creation of new jobs, technology will eliminate more jobs than it creates. Although most jobs created by the high tech industries will not themselves be high tech jobs, they will demand an educated work force with the ability to read, to write, and probably to compute.

Technology will not bring the chronically unemployed into the work force, but will instead add to that group many previously employed workers who are unable to cope with and utilize new skills.

It would be helpful if we could forecast accurately and in detail the job requirements of the next decade. The estimates we have are useful, but most of them are later found to underestimate our actual needs. I think we cannot underestimate the need for an informed and educated citizenry with sufficient educational background to allow them to move into and out of occupational patterns with new training as needs develop and change.

The intricate and dependent relationship between our educational system, our economic position, and our national security is increasingly being recognized by the general public. But the public needs leadership, guidance, and hope to make the serious commitments that are required to renew and revive our once first-class educational system.

Thank you.

[The prepared statement, plus additional material submitted by Ms. Vetter follow:]

SCIENTIFIC
MANPOWER
COMMISSION

A Participating Organization of the
AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE
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STATEMENT

before the

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY of the
COMMITTEE ON SCIENCE AND TECHNOLOGY
and the

TASK FORCE ON EDUCATION AND EMPLOYMENT of the
BUDGET COMMITTEE

U.S. HOUSE OF REPRESENTATIVES

by
Betty M. Vetter, Executive Director
Scientific Manpower Commission

June 9, 1983

The revolution in technology is expected to create fifteen million new jobs by 1990, including many of that did not even exist ten years ago, and others that will so modify the ways of performing tasks that traditional occupations will become unrecognizeable or will disappear. The kinds of jobs involved in tomorrow's technologies run the gamut from the highly creative to the monotonously routine, but the common denominator for professional jobs in high technology is a good background in mathematics plus a specialized knowledge of engineering, physics (particularly electronics), chemistry, geology, or biology.

The continuing development of technologies such as microelectronics, biotechnology, robotics, telecomunications and materials science will open up or expand a host of new industries concerned with extending human capabilities in a variety of ways. These industries will require professionals in a variety of specialties, both old and new, including some that are not related to the technologies themselves, but to product distribution and personnel management. In addition to jobs for engineers and scientists, these will include professional opportunities in sales, recruitment,

American Association for the Advancement of Science
American Astronomical Society
American Chemical Society
American Geological Institute
American Geophysical Union
American Institute of Chemists
American Institute of Physics
American Meteorological Society
American Nuclear Society
American Psychological Association
Federation of American Societies
for Experimental Biology
National Science Teachers Association
Society for Industrial and Applied Mathematics

personnel management, training course development, teaching, advertising and law.

In any one year, about eight million people in the U.S change jobs, according to a recent report from the Bureau of Labor Statistics.[1] Some unknown proportion of them change their occupation as well as their employer. This shift will undoubtedly get bigger as we move toward more technology in all kinds of occupational sectors. Indeed, another new study [2] by BLS finds that on average, an astonishing 23.2 million openings annually are projected for the 1980s, based on the low trend scenario, which will include those resulting from growth, replacement, and occupational changes (Exhibit 1).

Although a many of those jobs will be associated in some way with new technology, most of them will not require persons with specific training in science or technology. Indeed, no "high-tech" job even makes Labor Department's top twenty in terms of total numbers of jobs added to the U.S. economy, although several are in the 20 fastest growing occupations (Exhibit 2). Many will be in clerical areas, where secretaries will use word processors, and file clerks electronic filing systems, but these jobs, while requiring somewhat different skills, do not necessarily require more sophisticated ones.

On the other hand, the number of jobs for technicians in such areas as energy, hazardous waste management, industrial laser processing, industrial robot production and maintenance, materials utilization, genetic engineering, and computer assisted design, graphics and manufacturing are expected to total between four and five million, according to another study.[3] (Exhibit 3). BLS estimates projected openings for engineering/science technicians of 168,000 to 183,000 per year to 1990.[2] (Exhibit 4).

Shortages of technicians and skilled workers persist now despite record unemployment rates, according to employment executives in large corporations recently polled by the New York firm of Deutsch, Shea and Evans.[4] Today's hard-to-find specialists include electronic and electrical technicians; numerically controlled machine maintenance annd repair technicians; heating, ventilating and air conditioning technicians as well as such traditional skilled production people as machinists and tool and die makers. Present shortages vary by specialty and by geographic region, and so will future shortages. However, we can expect to add at various times shortages in many of the new technology areas as well as some of these current ones.

How good are the projections? Imperfect, certainly, because they depend on making a number of assumptions which may or may not prove to be true regarding the state of the economy, the choices of students, etc. The Bureau of Labor Statistics has changed its methods of estimating job openings to include not only those resulting from growth and death or retirement, but also to include those resulting from job switching, and from people entering or leaving the workforce temporarily. Thus, projections of average annual openings for engineers, forecast in 1980 at 46,500 per year for the 1978-90 period, have been adjusted to between 120,000 and 134,000 in the 1982 projections[1] (Exhibit 4). This makes the job outlook for engineers seem much different, and also seems to indicate significant shortages of engineers compared with the relative balance forecast just two years earlier and assuming the same average annual number of graduates. However, we cannot tell how many of those openings will be filled with the same persons, who are just transferring between employers. Equally large changes occur in projections for technicians, computer programmers, systems analysts and others. More numerical detail of projections to 1990 under various assumptions is provided in Exhibit 5.

The outlook for a supply/demand balance for technicians seems particularly gloomy. To train tomorrow's technicians, and even today's, more than two thirds of the employment managers participating in the DS&E poll[4] favored converting existing two year community colleges into advanced technical training schools wherever feasible. Most of the two year schools are not doing sufficiently sophisticated training now to meet industry needs, and many doubt their ability to do so in the future.

To make sure that they could, a number of things would have to happen. First, the quality of the high school graduate preparing to enter such programs would have to get better than it has been in the past few years. The mediocrity of our present pre-college education programs has been well documented in a number of recent studies but the ability to change the situation rests with solutions to many related problems having to do with the quantity and quality of high school science and math teachers (and the quality of those teaching in all fields), the requirements for graduation and for college entry (to two as well as four year or graduate institutions), the course-taking habits of secondary students, and all of the other factors that contribute to the present crisis situation in pre-college education. (A paper delineating the problems in regard to the supply of and demand for high school science and math teachers is provided as a supplement to this statement).

We can raise the requirements for graduation, as many states already are doing, and for college entry, as many higher education institutions are doing, but without the cadre of well trained, dedicated teachers needed to produce the desired result, real change will not occur. Teachers, too, must have access to and training to use new technology in their teaching programs, if we are to overcome the present deficit of quality teachers and quality educational programs.

Top quality teachers also will be needed for the community college-turned-technical institute. They, too, must be produced, and incentives to join their ranks must be sufficient to attract good people.

Although the numbers pale in comparison with the probable jobs for technicians, we must also continue to produce a sufficient number of engineers and scientists to teach, design, and carry out the research required to further develop and make full use of tomorrow's technology. We must also see that the results of this research are commercially developed in the U.S. rather than overseas, and this, also, requires professionals in the development area. It takes 20 years to produce a qualified scientist or engineer, of which the first ten to twelve years of training are crucial. If our public schools cannot attract and hold students in the sciences, we will continue to see the numbers dropping off.

The number of bachelor's graduates in science and engineering increased 35.5 percent between 1970 and 1975, but dropped two percent from 1976 to 1981 despite a ten percent increase in the number of women earning those degrees[5]. At the doctoral level, science and engineering degrees dropped by less than one percent from 1970 to 1975, and an additional three percent fromm 1976 to 1981. By sex, however, the number of men earning degrees in these fields fell 20.2 percent between 1970 and 1981 while the number awarded to women increased 145 percent, from 1500 to 3750.

These total decreases in science and engineering degree awards since 1975 occurred at a time when the college age population was still increasing fairly steeply. We head into the next decade with a declining college-age population, (dropping 26% by 1992); a well-documented drop in both the quantity and quality of pre-college math and science education, and severe shortages of qualified high school science and math teachers as well as engineering and computer science faculty.

I bring up the increasing participation of women in these fields because I believe that we cannot remain competitive in our increasingly technological world unless we do more rather than less to encourage the training and utilization in these fields of that half of our population.

You are already familiar with the comparative data in training in those countries with whom we are in competition, friendly or otherwise. (Many of them are detailed for your reference in the supplemental paper). Not only are we producing far fewer scientists and engineers per capita than other countries, but as the standard measures of academic performance show, our educational system is producing fewer and fewer able students in all fields.

As we utilize increasingly the fruits of high technology in industry, business and other areas, we will see new jobs created. However, we can expect technology to eliminate more jobs than it creates. Although most jobs created by the high tech industries will not themselves be high tech jobs, they will demand an educated workforce with the ability to read, write, and probably compute. The high tech jobs will require specific education and training in science and math. At present production rates, we may not have enough people with this training, and this will drive up salaries, thus encouraging industry to perform these tasks outside the U.S.

Traditional industries will utilize increasingly the tools of technology, and particularly computers, in all kinds of ways, from robotics to telecommunications. The forgotten worker will be the one who is unable to cope with and utilize these tools.

Technology will not bring the chronically unemployed into the workforce, but will instead add to the unemployed many previously employed workers who will have been replaced by robots. The increasing pool of functionally illiterate citizens will not be able to enter the mainstream of productive workers, and the line between the low-wage, unskilled service jobs at the bottom (which will decrease even as the population able to do only those jobs increases), the mid-level service and technician jobs, and the top level high tech jobs may create a three level society, with the bottom level not only failing to provide for its own maintenance, but increasingly resentful and rebellious against those who can operate in such a society.

It would be useful if we could lay out the numerical requirements with real accuracy - so many engineers, in particular subfield specialties, so many scientists in each field, so many technicians etc. The estimates available are useful guesses, but most such projections later are found to underestimate the actual needs. However, I believe we cannot underestimate the need for an informed and educated citizenry with sufficient educational background to allow them to move into and out of occupational patterns with new training as needs develop and change.

The intricate and dependent relationship between our educational system, our economic position and our national security is increasingly being recognized by the general public. But the public needs leadership, guidance and hope in order to make the serious commitments which will be required to renew and revive our once first class educational system. This effort is, I believe, the linch-pin required to assure our manpower needs in the coming decade. That is why, after years of concentrating only on the output of higher education, those of us concerned with technological manpower are now looking, both with horror and hope, at our pre-college educational system and at the needs to prepare for a far wider system of retraining than has ever been available in the U.S.

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ENDNOTES

1. Occupational Projections and training data, 1980 Edition, Bulletin 2052, September 1980; and Occupational Projections and Training Data, 1982 Edition, , Bulletin 2202, December, 1982, U.S. Department of Labor, Bureau of Labor Statistics

2. Hecker, Dan, "A Fresh Look at Job Openings," Occupational Outlook Quarterly, Spring 1983, pp. 27-29

3. Scientific, Engineering, Technical Manpower Comments Scientific Manpower Commission, Vol. 20, No. 4, May, 1983, pp. 4-6

4. Press Release, Deutsch, Shea and Evans, 49 E. 53rd St., New York, NY 10022, April 18, 1983

5. Series of Earned Degrees Conferred, 1970-1981, National Center for Education Statistics

EXHIBIT 1

Projected growth for occupations by average annual openings, 1980-90

Occupation	Projected openings (thousands)	Projected growth	Employment, 1980 (thousands)
Retail trade sales workers	1,199	as fast as average	3,347
Waiters and waitresses	788	as fast as average	1,711
Cashiers	648	faster than average	1,592
Secretaries	575	faster than average	2,500
Cooks and chefs	399	as fast as average	1,122
Bookkeepers and accounting clerks	373	as fast as average	1,715
Assemblers	364	as fast as average	1,670
Typists	299	as fast as average	1,067
Kindergarten and elementary school teachers	217	as fast as average	1,625
Carpenters	180	as fast as average	970
Registered nurses	179	faster than average	1,104
Engineering and science technicians	168	faster than average	885
Machine tool operators	155	as fast as average	1,020
Automobile mechanics	147	as fast as average	845
Bank tellers	125	faster than average	480
Engineers	120	faster than average	1,218
Licensed practical nurses	115	faster than average	550
Secondary school teachers	107	decline	1,237
Welders and flamecutters	106	as fast as average	573
Accountants and auditors	104	faster than average	897
Real estate agents and brokers	104	faster than average	582
Cosmetologists	77	as fast as average	514
Manufacturers' sales workers	71	as fast as average	437
Social workers	69	as fast as average	345
Computer operators	67	much faster than average	233
Electricians	63	as fast as average	560
Drafters	55	faster than average	322
Bank officers	55	faster than average	406
Plumbers and pipefitters	52	as fast as average	407
Insurance agents and brokers	46	as fast as average	327
Dental assistants	44	faster than average	140
All-round machinists	43	as fast as average	303
Brick layers and stonemasons	38	faster than average	163
Programmers	36	faster than average	228
Lawyers	34	faster than average	425
Air-conditioning, heating, and refrigeration mechanics	33	as fast as average	179
Systems analysts	28	much faster than average	205
Buyers	26	as fast as average	149
Printing press operators and assistants	26	slower than average	178
Automobile body repairers	25	as fast as average	153
Librarians	21	little change	145
Compositors and typesetters	20	decline	128
Purchasing agents	20	as fast as average	172
Computer service technicians	19	much faster than average	83
Television and radio service technicians	18	faster than average	83
Physicians	17	faster than average	405
Radiologic technologists	16	faster than average	106
Sheet-metal workers	17	as fast as average	108
Reporters and correspondents	12	as fast as average	57
Business machine repairers	12	much faster than average	55
Psychologists	12	as fast as average	106
Architects	6	faster than average	80
Dentists	5	as fast as average	126
Dental laboratory technicians	4	faster than average	53
Barbers	4	slower than average	112

SOURCE: Occupational Outlook Quarterly, Spring 1983, Bureau of Labor Statistics

EXHIBIT 2

TWENTY LARGEST JOB PRODUCERS AND FASTEST GROWING OCCUPATIONS

Largest Job Producers

	1980 employment	Projected growth 1980-90	Per cent growth
Secretaries	2,469,000	700,000	28.3%
Nurses' aides, orderlies	1,175,000	508,000	43.2
Janitors and sextons	2,751,000	501,000	18.2
Sales clerks	2,880,000	479,000	16.7
Cashiers	1,597,000	452,000	28.4
Professional nurses	1,104,000	437,000	39.6
Truck drivers	1,696,000	415,000	24.5
Fast-food workers	806,000	400,000	49.6
General office clerks	2,395,000	377,000	15.8
Waiters, waitresses	1,711,000	360,000	21.1
Elementary teachers	1,286,000	251,000	19.5
Kitchen helpers	839,000	231,000	27.6
Accountants, auditors	833,000	221,000	26.5
Construction helpers	955,000	212,000	22.2
Automotive mechanics	846,000	206,000	24.4
Blue-collar supervisors	1,297,000	206,000	15.9
Typists	1,067,000	187,000	17.5
Licensed practical nurses	522,000	185,000	35.5
Carpenters	970,000	173,000	17.9
Bookkeepers, hand	975,000	167,000	17.2

Fastest Growing Occupations

	1980 employment	Projected growth 1980-90	Per cent growth
Paralegal personnel	32,000	35,000	108.9%
Data processing mechanics	83,000	77,000	92.3
Computer operators	185,000	133,000	71.6
Computer analysts	205,000	139,000	67.8
Office machine servicers	55,000	33,000	59.8
Physical therapists	34,000	17,000	50.9
Fast-food workers	806,000	400,000	49.6
Computer programmers	228,000	112,000	48.9
Tax preparers	31,000	15,000	48.6
Employment interviewers	58,000	27,000	47.0
Speech, hearing clinicians	35,000	16,000	46.6
Correction officials	103,000	45,000	46.5
EDP equipment operators	49,000	21,000	44.0
Aero-astronautical engineers	68,000	29,000	43.4
Travel agents	52,000	22,000	43.4
Nurses' aides, orderlies	1,175,000	508,000	43.2
Insurance claims examiners	40,000	17,000	43.0
Economists	29,000	12,000	42.0
Brickmasons	146,000	58,000	40.2
Psychiatric aides	82,000	33,000	39.9

Source: Bureau of Labor Statistics

EXHIBIT 3

JOBS OF THE FUTURE

JOB TITLE	No. of Jobs	Starting Salary	Average Salary
Energy Technician	650,000	$13,000	$26,000
Housing Rehabilitation Technician	500,000	14,000	24,000
Hazardous Waste Mgmt. Technician	300,000	15,000	28,000
Industrial Laser Process Technician	600,000	15,000	25,000
Industrial Robot Production Technician	800,000	15,000	24,000
Materials Utilization Technician	400,000	15,000	24,000
Genetic Engineering Technician	250,000	20,000	30,000
Holographic Inspection Specialist	200,000	21,000	32,000
Bionic-Medical Technician	200,000	21,000	32,000
Automatic Fuel Cell Technician	250,000	12,000	18,000
On-line Emergency Medical Technician	400,000	16,000	29,000
Geriatric Social Worker	700,000	15,000	22,000
Energy Auditor	180,000	11,500	15,600
Nuclear Medicine Technologist	75,000	18,000	29,000
Dialysis Technologist	30,000	16,000	25,000
Computer Axial Tomography (CAT) Technologist/Technician	45,000	13,000	20,400
Computer-Assisted Design (CAD) Technician	300,000	18,000	30,000
Computer-Assisted Graphics (CAG) Technician	150,000	20,000	35,000
Computer-Assisted Manufac. (CAM) Specialist	300,000	20,000	31,000
Computerized Vocational Training (CVT) Tech.	300,000	14,000	22,500

Source: Forecasting International

EXHIBIT 4

COMPARISON OF 1980 and 1982 PROJECTIONS BY BLS

	1982 Projections				1980 Projections			
	1980	1990	% Change	Av. Ann. Openings	1978	1990	% Change Growth	Av. Ann. Openings
Comp. Serv. Tech.	83,000	160,000- 176,000	93-112	19,000- 21,000				
E/S Technicians	885,000	1,093,000-1,176,000	23-33	168,000-183,000	600,000	760,000	25	23,000
Programmers	228,000	340,000- 366,000	49-60	36,000- 40,000	247,000	320,000	30	9,200
Computer Operators*	223,000	387,000- 412,000	66-77	67,000- 72,000	666,000	665,000	- 0.2	12,500
Drafters	322,000	411,000- 445,000	28-39	55,000- 61,000	296,000	367,000	24	11,000
Engineers	1,218,000	1,552,000-1,672,000	27-37	120,000-136,000	1,136,000	1,441,000	27	46,500
Psychologists	106,000	129,000- 134,000	22-27	11,600- 12,200	130,000	171,000	32	6,700
Systems Analysts	205,000	343,000- 368,000	68-80	28,000- 31,000	182,000	250,000	37	7,900

* 1982 Projections include computer operators and peripheral EDP equipment operators.

1980 Projections include training for keypunch and other input technologies, computer operators and peripheral equipment operators and general data processing workers.

SOURCE: Occupational Projections and Training Data, 1980 Edition, U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2052, September 1980 and Occupational Projections and Training Data, 1982 Edition, U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2202, December 1982

EXHIBIT 5

Table C-1. Employment, 1980 and projected 1990 (three alternatives), and percent change, 1980-90 in occupations with 1980 employment of 5,000 or higher

(Thousands)

Occupation	Employment, all industries				Percent change		
	1980	1990 (Low)	1990 (High I)	1990 (High II)	1980-90 (Low)	1980-90 (High I)	1980-90 (High II)
Total, all occupations	102,107.3	119,591.1	127,908.4	121,448.5	17.1	25.3	18.9
Professional, technical, and related workers	16,395.2	19,662.3	20,727.6	19,917.4	19.9	26.4	21.5
Engineers [1]	1,177.8	1,504.3	1,624.3	1,531.2	27.7	37.9	30.0
Aeronautical and astronautical engineers	68.0	97.6	103.6	100.1	43.4	52.3	47.2
Chemical engineers	55.5	68.4	73.1	70.0	23.2	31.6	26.0
Civil engineers	165.4	207.9	217.2	210.3	25.7	31.3	27.1
Electrical engineers	326.7	441.2	479.9	449.2	35.1	46.9	37.5
Industrial engineers	115.9	145.7	159.3	148.3	25.8	37.5	28.0
Mechanical engineers	212.9	273.9	300.0	279.1	28.7	40.9	31.1
Metallurgical engineers	15.4	20.4	22.0	20.8	32.4	42.5	34.7
Mining engineers	6.1	8.4	9.2	8.7	37.7	51.2	42.6
Petroleum engineers	17.9	26.0	27.6	25.8	45.7	54.2	44.3
All other engineers	193.9	214.6	232.5	218.9	10.7	19.9	12.9
Life and physical scientists	253.8	300.2	317.3	305.6	18.2	25.0	20.4
Agricultural scientists	19.8	21.6	22.7	22.1	9.1	14.3	11.5
Biological scientists	44.8	51.2	54.1	52.5	14.1	20.7	17.0
Chemists	93.6	112.9	119.5	115.0	20.6	27.6	22.8
Geologists	39.8	51.7	54.9	52.0	30.1	38.2	30.7
Medical scientists	8.1	9.4	9.7	9.4	15.6	19.4	15.8
Physicists	20.5	23.1	24.4	23.6	12.5	19.0	14.8
All other life and physical scientists	27.1	30.3	32.0	31.1	11.6	18.1	14.5
Mathematical specialists	52.0	61.7	65.8	63.3	18.7	26.5	21.6
Actuaries	7.8	10.9	11.6	11.3	39.5	48.3	44.8
Mathematicians	12.7	14.4	15.2	14.7	13.2	20.0	15.8
Statisticians	26.5	30.9	33.2	31.6	16.7	25.2	19.3
All other mathematical specialists	5.0	5.6	5.8	5.7	10.9	16.3	13.2
Engineering and science technicians [1]	1,267.9	1,578.0	1,700.8	1,610.1	24.5	34.1	27.0
Broadcast technicians	16.5	17.8	18.4	17.8	7.5	11.4	7.7
Civil engineering technicians	24.6	30.7	31.6	31.1	24.8	28.4	26.2
Drafters	321.6	411.1	445.3	418.8	27.9	38.5	30.2
Electrical and electronic technicians	359.5	466.3	513.8	480.3	29.7	42.9	33.6
Industrial engineering technicians	32.4	40.2	43.6	40.8	24.0	34.4	25.7
Mechanical engineering technicians	48.5	60.9	67.1	62.2	25.5	38.2	28.1
Surveyors	61.3	72.9	78.0	75.4	18.8	27.2	22.9
All other engineering and science technicians	403.4	478.0	503.0	483.8	18.5	24.7	19.9
Computer specialists	432.8	683.1	733.9	697.2	57.8	69.6	61.1
Computer programmers	228.2	339.9	366.0	346.6	48.9	60.4	51.8
Computer systems analysts	204.6	343.2	367.9	350.6	67.7	79.8	71.4
Social scientists	189.6	242.4	255.4	248.0	27.9	34.7	30.8
Economists	28.8	40.9	43.3	41.5	42.0	50.1	44.0
Financial analysts	14.3	18.5	20.2	19.5	29.7	41.7	37.0
Psychologists [1]	82.5	106.5	111.1	108.5	29.2	34.8	31.6
Sociologists	6.4	7.7	8.1	7.9	20.3	27.4	24.5
Urban and regional planners	23.1	29.4	30.3	29.7	27.5	31.3	28.7
All other social scientists	34.6	39.4	42.4	40.8	13.8	22.6	17.9
Teachers	3,915.5	4,048.1	4,081.6	4,042.6	3.4	4.2	3.2
Adult education teachers	107.4	123.1	125.9	123.4	14.6	17.2	14.8
College and university teachers	457.4	405.1	406.6	404.1	-11.4	-11.1	-11.6
Dance instructors	22.5	25.6	27.2	24.8	13.5	20.5	9.9
Elementary school teachers	1,285.6	1,536.6	1,542.3	1,532.9	19.5	20.0	19.2
Extension service specialists	6.0	5.8	5.8	5.8	-3.1	-2.8	-3.4
Graduate assistants	132.1	108.7	109.1	108.4	-17.7	-17.4	-17.9
Preschool and kindergarten teachers	474.6	570.3	575.5	568.5	20.2	21.3	19.8
Secondary school teachers	1,237.2	1,061.6	1,065.6	1,059.1	-14.2	-13.9	-14.4
Vocational education teachers	27.0	33.2	34.2	33.3	22.8	26.5	23.2
All other teachers	165.6	178.2	189.3	182.4	7.6	14.3	10.1

SOURCE: Occupational Projections and Training Data, 1982 Edition, U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2202

Attachment to Statement before the Subcommittee on Science, Research and Technology of the Committee on Science and Technology and the Task Force on Education and Employment of the House Budget Committee, June 9, 1983.

SUPPLY AND DEMAND FOR SCIENCE AND MATH TEACHERS

by

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Adapted in June, 1983 from A Background Paper
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SUPPLY AND DEMAND FOR SCIENCE AND MATH TEACHERS

INTRODUCTION

There is abundant evidence of a shortage of qualified math and science teachers in the secondary schools, and some evidence of a diminishing quality as well. A potential shortage of scientists in some specialties, and of engineers and technicians will be exacerbated by a decline in pre-college math and science education. President Reagan recently described the problem as "serious enough to compromise America's future ability to develop and advance our traditional industrial base...."[1]

This paper will examine the extensive evidence of shortage of qualified science and math teachers, as well as the more limited evidence of a drop in quality; discuss some of the reasons why this has occurred; the accompanying indicators of changes in student achievement and the consequences of its continuation; and finally will summarize some of the steps being taken to alleviate the problem. Some comparisons will be made with the educational processes in other nations with whom we are in competition, both in defense and trade.

EVIDENCE OF SHORTAGE OF SCIENCE AND MATH TEACHERS

Surveys

.In the fall of 1980 and again in 1981 and 1982, the 50 state science supervisors were surveyed to assess supply and demand for secondary teachers of science and math.[2] Shortages found in 1980-81 worsened in each succeeding year. By 1982, only 3 states reported an adequate supply of math teachers, four of physics teachers and five of chemistry teachers. Conversely, the shortage was labelled critical in 21 states for math, in 27 for physics and in 16 for chemistry teachers. All but 9 have enough biology teachers and only 17 are short in general science. However, this survey probably underestimated the shortage since positions filled by unqualified candidates were not usually reported as vacancies.

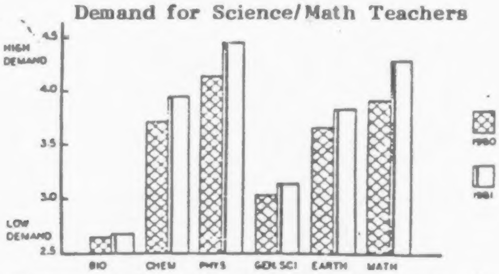
Table 1

Reported Shortage of Teachers in 50 States

	Critical Shortage		Shortage	
SUBJECT	**1980-81**	**1982-83**	**1980-81**	**1982-83**
PHYSICS	21	27	22	15
MATH	16	21	19	24
CHEMISTRY	10	16	25	30

Howe and Gerlovich, "National Study of Estimated Supply and Demand of Secondary Science and Mathematics Teachers," 1982, and "Where the Jobs Are," The Science Teacher, March, 1983

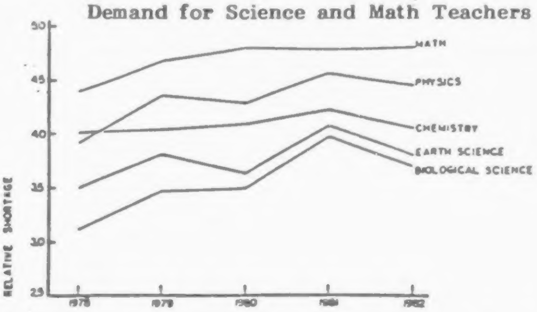
A survey of placement directors, expressed in terms of demand, as indicated on a scale from 0 to 5, confirms that the shortage is critical and worsening.



Howe and Gerlovich, "National Study of...
Science and Mathematics Teachers, 1982

Figure 1

.Between 1978 and 1980, college placement officers were surveyed by James Akin,[3] who found "considerable shortages" of teachers for mathematics, physics, chemistry and general science. This survey found that 22 percent of the high school teaching posts in math across the nation were vacant.



J.N. Akin, "Teacher Supply and Demand: A Recent Survey," ASCUS, 1980.

Figure 2

.In December 1981, the National Science Teachers Association (NSTA) surveyed 600 colleges and universities with teacher training programs and found a 77% decline from 1971 to 1980 in the number of math teachers, and a 65% decline in the number of science teachers prepared to teach in secondary schools.[4] Further, the study found that in addition to a severe decline in the supply of persons trained to teach science and math, the fraction of those trained who enter teaching also has declined. The combined effect is a 68%

reduction in newly-employed science teachers and an 80% reduction in newly employed math teachers since 1971.[5]

Table 3

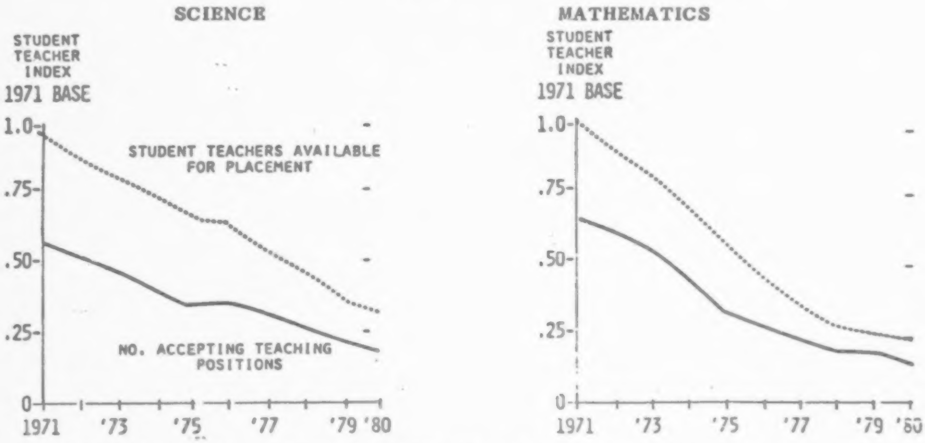
Index of Science/Math Teacher Supply Data 1971-80
1971 = 100

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
SCIENCE										
Graduating Teachers	100	90	85	75	65	65	55	50	40	35
% Entering Teaching	59	58	58	55	56	59	56	52	54	54
MATH										
Graduating Teachers	100	91	86	73	60	45	36	27	27	23
% Entering Teaching	63	68	64	65	62	61	63	59	60	55

Based on a sample of 140 university/college placement officers.
Shymansky, NSTA Survey of College and University Placement Officers, 1982

The effect of these changes is shown even more forcefully when the data are in graphic form.

Student Teacher Supply Index Based on 1971 Supply



Shymansky, NSTA Survey of College and University Placement Officers, 1982
Figure 3

.Another NSTA survey of a random sample of 2,000 secondary school principals, also conducted in December 1981, and analyzed by James Shymansky of the University of Iowa, requested information on the qualifications of those science and math teachers who were being hired.[6] The survey found that 50.2% of newly-employed teachers were unqualified to teach science or math, but were employed on an "emergency basis" because no qualified teachers could be found.

Examined by census regions, the findings show severe problems in states where high technology industries require the best-trained science and math personnel.

Table 4

Qualification of Newly-Employed Science/Math Teachers

Census Region	Percentage of Newly-Employed, but Unqualified Science/Math Teachers 1980-81	1981-82
Pacific States	75%	84%
Mountain States	44	43
West North Central States	26	43
West South Central States	63	63
East North Central States	23	32
East South Central States	43	40
Northeastern States	11	9
Middle Atlantic States	40	46
South Atlantic States	48	50
All States	**45%**	**50%**

Shymansky, NSTA Survey of Secondary School Principals, 1982

.The National Center for Education Statistics conducted a survey of teacher demand and shortages during the 1978-79 school year, and found that a shortage of 600 teachers represented 2.4 percent of all employed teachers in the physical sciences.[7] In mathematics, the shortfall of 900 teachers represented only .6 percent of employed math teachers, but the proportional shortfall has climbed well above that figure since 1979.

Number of New Graduates

.Nationwide, the number of new teachers graduated in the past decade has dropped from 36 to 21 percent of all college graduates. The number of education graduates with a major in mathematics dropped from 2,217 in 1971 to 798 in 1981, while the number of science education graduates dropped from 891 in 1971 to 597 in 1981.[8] This number, of course, includes biology teachers, chemistry teachers, physics teachers, earth science teachers and general science teachers.

Finally, only 5 percent of all college bound seniors in 1982 (2.2 percent of males and 7.4 percent of females) indicate plans to major in education,[9] and only 1.3 percent of all education majors graduating in 1981 majored in science or mathematics education.[10]

Thus, it is apparent that there is a severe and worsening shortage of science and math teachers for secondary schools, and that present enrollment trends do not offer hope that the situation will change over the next few years.

Shortages in the States

Some states, and even some cities report far more difficulty in filling their science and math teacher positions with qualified candidates than do others. No national data are available on a state by state basis, but several states have made some surveys of their own.

North Carolina. Each year, North Carolina colleges and universities report to the State Department of Public Instruction the number of completions in teacher education; and the superintendent of each school district reports a vacancy count, by field. However, math teacher positions filled by teachers not certified in mathematics are not considered openings. An analysis of these reports over the past twenty years by Robert T. Williams of North Carolina State University[11] found that the percentage of new math teachers as a fraction of all new secondary teachers has declined steadily since 1967.

Further, the number of reported vacancies for math teachers has been declining since 1969, and in most years, the number of new math teachers exceeded the number of vacancies. However, the same reports reveal that in none of the 20 years were more than 58 percent of the prior year's graduates actually teaching in the fall and the proportion fell as low as 20 percent.

Table 5

Certification Status of North Carolina Math Teachers

Number of Math Sections	Teachers with Math Certification	Teachers Without Math Certification	All Teachers
1	54	494	548
2	113	680	793
3	174	335	509
4	274	179	453
5	1,557	266	1,823
6	395	161	556
>6	11	7	18
TOTAL	2,578	2,122	4,700

The result of the effort over the years to fill every classroom with someone, whether qualified to teach the subject or not, has resulted in a situation where only 55 percent of North Carolina's 4,756 math teachers are certified in mathematics. Among the 2,123 non-certified math teachers, 441 (21%) taught a full load of math classes, while others taught only a partial load.

Many of the non-certified math teachers were certified in social studies, physical education, grammar, science or business.

Also of interest is the teaching assignment for certified and non-certified math teachers.

Table 7

Mathematics Teaching Assignments

	Teachers	
	Certified in Mathematics	Not Certified in Mathematics
Junior High/Middle School	1,759	1,796
High School General Math	919	800
Algebra 1	1,410	93
High School College-Prep	1,723	52
Remedial Mathematics	138	307

Missouri. Only about half of the 80 prospective math teachers who will graduate from Missouri's teaching institutions are expected to be teaching the following fall, although at least 200 vacancies are expected in the state. The number of emergency certificates issued in 1979 was up 43 percent over 1978.[12]

New York. Only 32 graduating college seniors planned to teach junior or senior high mathematics in 1982.[13]

New Hampshire. Only one college graduate in the state in 1982 is planning a career in mathematics teaching. In 1980, there were 41 openings for math teachers in New Hampshire high schools, but only six graduates of teacher education programs throughout the state sought math teacher certification. In 1981, the lone graduate did not take a teaching job.[14]

California. Among more than 400,000 students in California's public four-year institutions in the spring of 1982, only 97 were preparing to be secondary mathematics teachers.[15]

Texas. In 1982, twenty graduates were certified for mathematics teaching, but only seven entered teaching.[16]

Maryland. A survey by the state Department of Education at the end of the 1979-80 school year estimated that 50,000 secondary students received their mathematics instruction from more than 400 teachers who were not certified to teach secondary mathematics. In 1982, only 17 new math teachers graduated in the state, and eight entered teaching.[17]

Connecticut. The state lost 100 math teachers last year through retirement or job shifts, while only 28 math teachers graduated from the 14 state institutions.[18]

New Jersey. An emergency shortage of math teachers has been declared by the State Department of Education in 17 of New Jersey's 21 counties. This emergency designation permits districts to use unlicensed teachers - some without a bachelor's degree - to teach mathematics.[19]

Iowa. The number of graduates prepared to teach mathematics dropped from 234 in 1970 to 60 in 1979. The number of vacancies during that period fluctuated between 200 and 250 each year. The smaller school districts have the most severe shortage.[20]

Mississippi. The state superintendent of education reports that state institutions do not even come close to providing the 400 to 500 math teachers that will be needed this year.[21]

Virginia. Following a survey of the 141 school systems in Virginia (133 reporting), the State Council of Higher Education reports that "The supply of teachers available to hire is not sufficient to meet current demand in particular fields." Almost half of the divisions in the state said they were having extreme difficulty finding mathematics teachers; more than one third had problems finding teachers of earth science, and one fourth report extreme difficulty finding qualified teachers for chemistry and physics courses. Almost half of the earth science teachers in the state are uncertified in the field, despite six year old regulations that all earth science teachers be endorsed by the 1982-83 school year. Seven percent of the state's chemistry teachers do not meet the requirements for certification in that field.

The number of students graduating from the state's 33 state-approved college education programs has fallen 25 percent in the last four years; the number of student teachers in science and mathematics decreased threefold in science and fourfold in mathematics from 1971 to 1980, and only half of the student teachers have been entering the teaching profession after graduation.[22]

Teacher Exodus to Industry

Compounding the problem of an undersupply of new graduates in science and math education is a serious exodus of experienced teachers to industry. The average age of science/math teachers is 41, according to an NSTA survey of science teachers, and the average experience is 16 years. However, almost five times more science and math teachers left teaching last year for employment in non-teaching jobs than left due to retirement. If the present exodus of qualified science and math teachers from secondary schools continues at the 1980 and 1981 rate of four percent per year, there will be a net loss of 35 percent by 1992.[23]

One of the NSTA surveys also found that one in four teachers among the younger faculty plan to leave teaching completely.[24]

Another survey in North Carolina finds further that those planning to leave are predominantly those who are best qualified, while those planning to continue a career in teaching are those least qualified on the basis of preparation and test scores.[25] Although there is no documentation, it appears probable that those who have left teaching in the past few years also are among those best prepared in science and math, and therefore most desireable as employees for industry.

The reasons for the teacher exodus to industry are generally so obvious as to need no explanation - higher salary levels, more opportunities for advancement, an environment conducive to accomplishment, more respect from society, adequate equipment, etc.

QUALITY OF NEW SCIENCE AND MATH TEACHERS

The drop in quantity, which is readily documented, also appears to be accompanied by a drop in quality of new graduates preparing for secondary teaching. Quality is much harder to measure than quantity, but some indicators of quality can be examined. One of the most obvious is test scores of students planning majors in education.

The College Board reports that among college bound seniors in 1982, the average verbal score on the Scholastic Aptitude Test was 426 and the average score on the mathematical portion of the Scholastic Aptitute Test was 467. Among students indicating plans to major in education, the verbal scores average 394 and the math 419. Thus, as a group, students planning to teach are considerably below average in this measure of quality.[26] The scores on the Graduate Record Examination and the National Teacher Examination also indicate that students currently enrolled in teacher education programs are the least competent, by comparison with those preparing for other professional careers.

Further, the least competent of the teacher education graduates also appear to make up the bulk of those who plan to remain in teaching. For example, a study of teacher recruitment, selection and retention in North Carolina found a dramatic difference in the teaching plans of those highest and those lowest in ability. Of those in the upper 20 percent of measured academic ability, only 26 percent intend to teach at age 30, contrasted with 60 percent of those with the lowest academic ability.[27]

The National Center for Education Statistics confirms that the number and academic standing of high school seniors planning to major in education were lower in 1980 than in 1972; and that the academic records of both women and men planning an education major were lower in comparison with their 1980 classmates planning to major in other fields and also with their 1972 counterparts.[28]

Basing findings on an analysis of data collected in the 1980 High School and Beyond study and in the National Longitudinal Study of the High School Class of 1972, NCES examined cognitive test scores, questionnaires about backgrounds, high school experiences and plans of these two groups of students. Those planning to attend college were asked about their intended field of study.

Ten percent of women college aspirants planned to major in education in 1980, down from 18.8 percent in 1972. Among men, the segment planning education majors declined from 6.0 percent to 3.4 percent in those eight years. About three times as many women as men planned an education major, and white women made up about 67 percent of all students planning such a major. White males were second (19%) followed by black females (5%), Hispanic females (3%) and others.

Students planning to major in education had lower scores than other college aspirants on reading, vocabulary and math tests; their grade point averages were lower than those of students planning other majors; and the number of math and science courses taken in high school was less for education majors than for others, as was the proportion of courses taken that were in academic subjects. Although these differences in academic qualification are more pronounced among males than among females, they apply in both cases.

Table 7

Mean Academic Preparation Measures of College Aspirants, by Sex and Intended Major: 1980

Academic Preparation Measure	TOTAL		MALE		FEMALE	
	Education Major	Other Major	Education Major	Other Major	Education Major	Other Major
TEST SCORES						
Reading	52.31	54.77	51.86	55.13	52.45	54.42
Vocabulary	51.69	54.55	51.75	55.20	51.70	53.91
Math	51.54	55.02	51.79	56.58	51.46	53.51
GRADE POINT AVERAGE*	6.25	6.36	5.79	6.18	6.39	6.53
NO. OF MATH COURSES	2.53	3.12	2.50	3.30	2.53	2.95
NO. OF SCIENCE COURSES	.62	.94	.74	1.09	.59	.78
PROPORTION IN ACADEMIC PROGRAM	.55	.66	.47	.68	.58	.64

*Self reported, on a scale of 1-9

National Center for Education Statistics

Among women, the differences in academic qualifications between those planning to major in education and those entering other fields appears to be widening. We have no data separating potential science and math teachers from other teachers, but as we have noted, teachers not qualified in math and science but with other education credentials are teaching those subjects anyway. Thus we must be concerned with these findings.

The mathematics tests used with the class of 1972 and the class of 1980 were different, and cannot be compared. However, we can see scores on reading and vocabularly tests compared, and the drop across time and relative to students planning other majors is evident for both sexes.

Table 8

Mean vocabulary and Reading Test Scores of College Aspirants by Sex and Intended Major, 1972 and 1980

Test	Intended Major	Male Seniors 1972	Male Seniors 1980	Female Seniors 1972	Female Seniors 1980
Reading					
	Education	10.59	9.69	11.88	9.99
	Other	12.03	11.16	12.35	10.84
Vocabulary					
	Education	6.50	6.20	8.05	6.59
	Other	8.19	7.43	8.49	7.31

Scores are mean formula scores (i.e. number of correct answers adjusted for guessing). Maximum scores are 20 on reading and 15 on vocabulary.

Some of the states also have examined the quality of education majors. For example, Virginia reports that the students who enter its education programs tend to have lower entrance test scores than those who enter other college programs.[29] Education majors at state universities scored an average of 121 points lower on the combined math/verbal S.A.T. than did their counterparts who graduated in other fields. At private colleges, education graduates scored 80 points below others at their schools.

CHANGES IN STUDENT ACHIEVEMENT

Test Scores

Since 1962, at the height of the post-Sputnik push for better U.S. math and science training, math scores on the Scholastic Aptitude Tests have fallen steadily.[30] The National Assessment of Educational Progress has found a sharp drop in the ability of students, particularly 17 year olds, to apply classroom theory to the numerical problems of everyday life, over the two assessments of math skills conducted in 1973 and 1978. In this same age group, there has been a steady decline in the science achievement scores as measured in the three national assessments in science in 1969, 1973 and 1977.[31]

Lowered scores have not been limited to the SAT and the National Assessment of Educational Progress testing programs. Consistently lower annual mean scores also have been registered on the American College Tests (ACT), the Comprehensive Tests of Basic Skills (CTBS) the Iowa Tests of Educational Development (ITED) and the Minnesota Scholastic Aptitude Test.[32]

The decline in average SAT scores may finally have reached its nadir, since the 1981 mean scores were the same as those for 1980, and the scores in 1982 actually increased slightly because of an increase in the scores of black students. In the 1982 tests, black scores rose an average of 9 points on the verbal side and 4 points on math, while whites gained two points in verbal and remained at the same level in math.[33]

Declines in test scores during the 1960s and 1970s have been attributed to a host of problems in home, school and society. The relationship between quality of math teachers and student math scores is not quantifiable, but a declining score pattern might in part be a cause and in part an effect of a shortage of qualified science and math teachers.

Some educators and non-educators have attributed this slide to the "new math" programs introduced during the late 1960s, while other studies show that math achievement is higher for students using the new curricula than for those taught in the traditional way.

High School Graduation and College Entrance Requirements

Other indicators of student achievement also should be noted.

Since 1970 there has been a nationwide trend toward reduction in the number of courses in math and science, as well as in such areas as foreign language that are required for a high school diploma. Only one third of the nation's 17,000 school districts required more than one year of mathematics and science for graduation in 1982, and one half of all high school graduates take no math or science at all beyond the tenth grade.[34]

As a group, colleges and universities also have lowered their requirements for admission. This has necessitated extensive increases in remedial courses in most institutions. Remedial malthematics enrollments at four year institutions increased 72 percent between 1975 and 1980, compared to a seven percent increase in total student enrollments for the same period. In public four year colleges, 25 percent of the mathematics courses presently being taught are remedial, and at two year colleges, 42 percent of these courses are remedial.[35]

A recent study by the National Academy of Sciences also documents a decline in the number of science courses taken by college students who are not specializing in science, engineering or other science related professions. In 1980, the average non-specialist college student devoted only 7 percent of course work to science.[36]

The proportion of high school students who have taken science and math courses which would prepare them to enter and understand college courses in this subject has grown smaller, and the proportion who are fully prepared to major in a quantitative field includes less than a third of all graduates, and less than a fourth of those who enter college.

Two studies by the National Center for Education Statistics provide information on the science and math preparation of high school seniors. One shows the proportion of all seniors in the spring of 1980 who had taken particular math and science courses.[37]

At a time when extensive efforts are being made to bring more women into science and engineering fields, their consistently lower participation in math and science courses is troubling. Only 28% of those in the 1980 high school class took three or more years of mathematics in grades 10-12, and only 18.5 percent took three or more years of science. About twice that proportion (30.1 percent) completed two to two and a half years of science.

Table 9

Percent of Seniors Who Took Courses, Spring 1980

Course	Total	Men	Women
Algebra I	79.3	78.7	77.9
Algebra II	49.0	51.3	47.0
Geometry	56.2	58.0	54.6
Trigonometry	25.6	29.9	21.7
Calculus	7.8	9.8	6.0
Physics	19.4	25.7	13.6
Chemistry	37.3	39.2	35.4

National Center for Education Statistics

The situation is somewhat more promising if we examine the average number of semesters of science and math taken in grades 10-12 by high school seniors in 1972 and 1980. Here we see some increase in participation.

Table 10

Average Semesters Taken by Seniors in Grades 10-12

Subject	All Students		Men		Women	
	1972	1980	1972	1980	1972	1980
Mathematics	3.6	4.1	4.0	4.3	3.2	3.9
Science	3.4	3.4	3.7	3.6	3.1	3.2

However, the small increase in science courses taken by women is accompanied by a small decrease among men. Both sexes have increased the number of semesters of mathematics taken during their high school years.[38]

Cause or Effect?

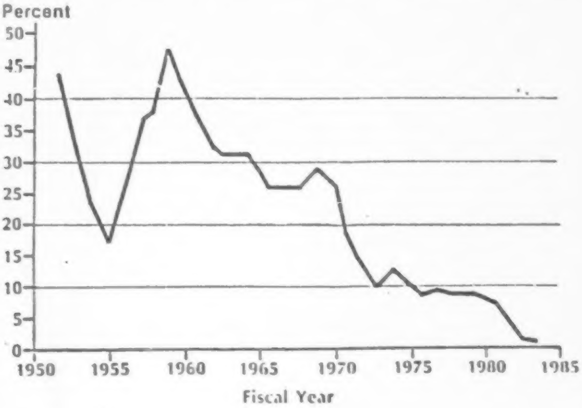
If good teachers are leaving, and only the poorer students are entering teaching, is this a reflection of the low salaries paid to teachers; or are low salaries a reflection of the quality of teachers and teaching as seen by the taxpayers who must vote, directly or indirectly on those salaries? Is the inability to raise salaries for teaching fields in short supply attributable to union rules and seniority practices; or is it because citizens see science and math fields as unimportant enough to be taught by unqualified teachers? How important is the fact that able women interested in math and science no longer are relegated to teaching as the only acceptable place to utilize their talents?

Why have scores on the math S.A.T. declined so steadily for so long? Is it poor or uninspired teaching that has resulted in continuation of the score decline long after the original shakeouts of adding significant numbers of students who would not have planned to go to college in earlier years? Or has the continuing decline in test scores resulted in a lessening of quality among those who seek to enter teaching careers? Or are all of these intertwined as both causes and effects?

FEDERAL SUPPORT FOR SCIENCE/MATH EDUCATION

The support of the National Science Foundation for such activities as summer workshops for teachers, and other in-service training disappeared several years ago, although the FY 1984 budget includes $5 million for such a program. For the past two years, the Administration has indicated that previous support for science education was extensive, had not succeeded and should be dropped. The facts are just the opposite. NSF support for science and engineering education has declined steadily and steeply for the past 22 years, with science education's share of the NSF budget dropping from a high of 47% in 1959 to its present low of two percent.

NSF Science Education Funding as a Percent of Total NSF Budget



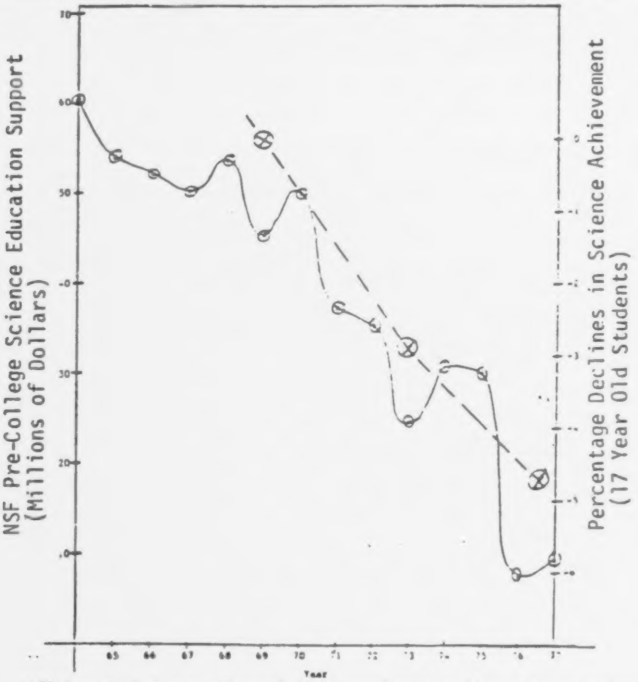
National Science Foundation

Figure 4

The FY 1984 budget, however, includes $39 million for science education, with 51 percent targeted for precollege teacher improvement in science and math activities. Further, $50 million is to be provided to the states in matching grants for one year scholarships to retrain unemployed graduates, teachers in surplus fields, or retirees as science or math teachers. This crash program aims to produce 7,000 more teachers per year.

NSF support for pre-college science education dropped sharply, from 72% of the Foundation's science education budget in 1959 to 22% in 1980. In 1982, the entire division of science education was eliminated. The decline in NSF support correlates quite directly with declining achievement in science as measured by the National Assessment of Educational Progress. While this does not necessarily imply a cause and effect relationship, when coupled with other evidence the relationship appears reasonable.[39]

Declines in NSF Support of Pre-College Science Education Correlated with Declines in Science Achievement at the Secondary Level



National Science Foundation and Education Commission of the States

Figure 5

CURRICULUM DEVELOPMENT

Another reason for the decline in quantity and quality of math teachers probably is the fact that curriculum development activities have been almost dormant since the post-Sputnik efforts. Although there has been much criticism of the "new" curricula produced with NSF support, a recent study indicates that they were far more successful than most people realized.[40] In an analysis of 105 studies involving 45,000 students, comparisons were made between those enrolled in new science curricula and those in traditional curricula. On every measure, including attitude, achievement, and process skills, students taking the new NSF curricula scored overall 14 percent higher. Students in the BSCS Biology and Chem Study programs scored 17% higher than those in traditional programs. Perhaps most important is that students from low socio-economic groups scored 24 percent higher using the new curricula, which gave minority children in those programs a decided edge over similar children exposed to traditional curricula.

These studies covered a period of several years in the 1960s and 1970s. Few teachers are left in the schools now who are qualified to teach the new curricula, and almost none have been given the important in-service training since NSF stopped support several years ago. Further, these programs are in serious need of modification and revision to take into account the developments of the past twenty years in such areas as computers, modern electronics and technology applications.

Only if teachers find their subject interesting can they transmit that interest to their students. Teachers who are themselves unskilled in their subject matter; or who are utilizing teaching materials they do not understand or appreciate; are unlikely to inspire interest in the subject among their students.

INTERNATIONAL COMPARISONS

The declining emphasis on science and mathematics in the U.S. school system is in marked contrast to that of other industrialized countries.[41] Japan, Germany, and the Soviet Union all provide rigorous training in science and math for all their citizens. Comparative studies in science and engineering education suggest that students in these countries are getting the kind of education that may allow them to overtake the U.S. in scientific and technological advances with both industrial and military applications.

.For example, almost 100 percent of Soviet students complete secondary education, compared with 75 percent in the U.S. Compulsory science in the U.S.S.R. includes five years of physics and four of chemistry, while fewer than 20% of U.S. high school graduates take one year of physics, and only 37% take one year of chemistry. With school populations of similar size, Russia employs about 123,000 physics teachers compared to 10,000 in U.S. schools. Further, Russian teachers in science and math carry out a research project in their major field during their college years, which is reviewed by a faculty committee. Local colleges and universities assume responsibility for a continuing program of in-service education for teachers.

Soviet schools meet six days a week for six to eight hours per day, for 210 to 228 days. U.S. students attend for five hours, five days a week, for 180 days, or a total of 161 days.

The U.S.S.R. offers its students sequences of course material in science and math starting with an intuitive level of understanding; progressing to empirical levels and finally to formal axiomatic and theoretical understandings. U.S. students entering these subjects are immediately introduced to abstractions, without the prior steps. For many students, these concepts seem hopelessly difficult, so they fail or drop out, or, on advice of others, simply avoid taking the courses because they believe them to be difficult.

All Soviet students study algebra, compared with only half of American students. Indeed, half of all U.S. high school graduates take no mathematics at all beyond the tenth grade. Calculus is taken by all Russian high school students, but by only 3 percent of U.S. students. Seven states require no high school math at all.

.Nearly all college bound students in Japanese secondary schools take three natural science courses and four math courses during their three years of high school. While SAT scores were dropping in the U.S., achievement test scores of Japanese seniors increased from 54 percent in 1964 to 71 percent in 1981 - a gain the Japanese attribute to "modernization of the curriculum." By 1970, Japanese seventh graders ranked first in math over students from 12 industrialized countries including the U.S., and in both the ten and fourteen year old age grouups, scored first among 19 nations in science tests. In the second international competition, involving 23 countries, which is currently being conducted, Japan's preliminary results show significantly increased scores over those of Japanese student's 1970's scores in both algebra and analysis, including calculus.

It is not surprising, then, that from 1963 to 1977, industrial productivity grew 197 percent in Japan, compared with 39 percent in the U.S. Japan dominates the auto and steel production industries, has almost eliminated competition in consumer electronics, is the industrial leader in robotics and optical electronics, and is rapidly overtaking the U.S. in semiconductors, computers, and perhaps even genetic engineering.

.In West Germany, there is a standard curriculum for all students through grade ten, and the only variation is in specialized science-oriented schools where each subject is studied more intensively.

.It is a reflection of these differences that on a per capita basis for the relevant age group, for every engineer graduated in the United States, the United Kingdom produces 1.1; West Germany 1.4; Japan 2.6 and the Soviet Union 4.1.

PUBLIC SUPPORT FOR SCIENCE AND MATH EDUCATION

The interim report of the National Science Board's Commission on Precollege Education in Mathematics, Science and Technology[42] notes that the public has not understood the importance of a firm grounding in science and math for all citizens, but such understanding seems to be increasing.

For example, strong support was given in the Ninety Seventh Congress to Bills on this issue, and science education will be the subject of major legislative efforts in the Ninety Eighth Congress. Administration support is indicated by the FY 1984 budgets for science education.

Some states have made serious strides in pushing improved math and science education. Eighteen states have enacted legislation to raise standards of eligibility for teacher education, although this move has not generally been accompanied by incentives to attract better students. Public institutions in eight western states have announced or imposed admission standard changes or are discussing changes for the future, including tightening requirements to include more high school courses, especially in English and mathematics.[43]

Public opinion polls show that math and science education both rate high among items taxpayers are willing to support with their taxes. Mathematics ranked at the top in a Gallup survey of subjects deemed "essential" by the general public for high school students, with 97 percent of respondents placing it in that category. Science got 83 percent, coming in fifth behind English grammar and composition, civics and government and U.S. history.[44]

CONSEQUENCES OF THE TEACHER SHORTAGE

The result of shortages of qualified science and math teachers already are being felt, and will worsen if nothing is done. Some schools have dropped math courses, particularly advanced courses, for lack of qualified teachers. Many schools no longer offer physics. Almost all districts have had to utilize teachers not certified in these subjects, and the results often have been less than inspiring. Present and projected shortages of students who are both qualified for and interested in careers in science and engineering cannot be rectified unless a higher proportion of the diminishing high school population is given the necessary preparation in high school to enter these curricula at the college level.

The need for technical personnel in the armed forces is well known. These needs range from the enlisted personnel required to maintain and use all kinds of technical equipment to the engineers and scientists who develop and use sophisticated weaponry. A recent Air Force report, examining scientific and engineering shortfalls,[45] concludes that "Unless corrective action is taken, the USAF anticipates shortages of at least 10-15 percent in military personnel with the most current scientific and engineering requirements." Equally important, however, is the fact that some military equipment is standing idle because too few enlisted men have the prerequisite background in math and science for training in the use and maintenance of the equipment.

A national study conducted in 1980 shows that only 18 percent of the U.S. adult population is interested in and informed about scientific matters, varying from 4 percent for persons with less than a high school diploma to 55 percent of those with a graduate degree. Only a small percentage of Americans indicate they would definitely take an active part in controversies involving science and technology, and only one in seven has a minimal understanding of what it means to study something scientifically.[46] This leads inevitably to an electorate which may support or protest difficult policy decisions on an emotional rather than an informed basis.

This is not the first time the U.S. has fallen behind in some aspect of technological development, but the consequences of this present lag, if no change is made, could be far more serious than in previous circumstances because of the rapidity of technological advancement.

There is no exaggeration in reporting that the science and math teacher shortage and its consequences is at a crisis level. Some movements are afoot to alleviate that crisis; but in other areas we do not seem to care enough to take whatever steps would be required to provide an adequate supply of well-trained, interested science and math teachers, and the equipment and supplies necessary for them to do their job well. Most school districts are unwilling to raise teacher salaries as they must be raised to attract and retain competent teachers, although most citizens in those districts probably would recognize that in a democracy, we tend to recognize worth by the salary levels we establish for particular activities. Despite unemployment rates now in double digits, we are not taking the necessary steps to provide the educational background at the pre-college level that would allow and encourage many more of our citizens to become proficient in those skills for which jobs still go begging, even during periods of high unemployment.

As we move to resolve the crisis, we might keep in mind a lesson from the Chinese. The calligraphy for their word meaning "crisis" consists of two words: "wei", meaning dangerous, and "chi" meaning opportune. Perhaps more emphasis on the opportunity that exists in this crisis might help us to alleviate the danger.

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4. Preliminary results of a December, 1981 NSTA Survey of 600 Colleges and Universities with science and math teaching programs, as reported by Klein, op. cit.

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30. College Entrance Examination Board, op. cit.

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Mr. GEPHARDT. Thank you very much. I thank all of you for truly excellent testimony.

Representative MacKay.

Mr. MACKAY. I am concerned about the implications of this testimony in the sense that in some ways it seems to indict our present public school system. That indictment is sort of the popular thing for elected officials and candidates to talk about in terms of shortages in math and science and lack of rigor in the curriculum. I want to talk about our vocational education programs.

One of the things that has concerned a lot of people is the seeming lack of relationship between our curriculum in our vocational educational programs and our job needs. If technology is causing a greatly enhanced or greatly increased rate of change, then what is now a problem is apparently going to get to be a greater problem. I would like to ask any of you who would care to to comment on how we should change that. Should we go more to an industry services approach with the State being the owner of the equipment and moving that equipment in place where it needs to go to train specifically for industry? Should we forget about theoretical vocational programs in the secondary schools and go strictly to training? I am interested if anyone has started looking at that.

Dr. BENDICK. There is pretty clear evidence on what works well in vocational eduation and what doesn't. The largest pattern, which is quite clear, is that there is a much greater payoff efficiency and effectiveness in post-secondary vocational education than secondary vocational education. Secondary vocational education is a very weak system in general.

Mr. MACKAY. Let me break in right there. When you say there is a greater payoff, do you mean that from the standpoint of knowing that those people you have trained are, in fact, trained or do you take into account those who drop out of the traditional academic setting?

Dr. BENDICK. What secondary school vocational education often is now is a last resting place for someone who is in other circumstances a dropout. There is a lot of room for creative innovation in American secondary schools on what to do with students having a lot of problems and threatening to add to our disadvantaged worker population through becoming high school dropouts. Sticking them in a weak vocational education curriculum is not really the best thing to do. It doesn't necessarily help them very much. It certainly doesn't do any good in terms of the vocational curriculum itself.

Careful studies show that a student going through a high school vocational education curriculum in general has no better chance of getting a job—a well-paid job or a job in the field in which he has had vocational training—after graduation than does a student who went through the general or academic track in most secondary schools. Secondary school vocational education does not seem to be doing a very good job of vocational training, in short.

Probably the short answer on what to do about reforming vocational education would be to develop some other innovative systems for handling students who are not very comfortable in secondary schools and threatening to drop out. Then concentrate secondary school education much more on basic skills such as reading, writing, and computing and shift most of the vocational education resources to the post-secondary system where they seem to be very effective.

Mr. MACKAY. Mr. Chairman, I apologize for going too long, but does that then imply if you are going to shift vocational training out of the secondary school because you are saying, in effect, it is not performing either a training function or a counseling function, does that then imply that you have got to do something about guidance in the secondary schools, vocational guidance which I think to be nonexistent at the present time?

Dr. BENDICK. I think that probably is also helpful in the sense that most secondary school vocational guidance systems are weak and students may be making worse decisions because of it.

Mr. MACKAY. Do you know of anyplace where there is a model where this is being done right? I hear that in Europe they approach the whole question of guidance differently. They have an employment service not connected to the schools, but located on the school campuses.

Dr. BENDICK. Yes, that is true in many nations. For example, in Sweden, which I recently visited, you can go to a fullservice employment service office on site at the training school. That probably makes a lot of sense.

Mr. MACKAY. If you would care, Ms. Vetter.

Ms. VETTER. I would only like to add that we should spend the time that the high school vocational education program now takes to instead try to teach the remedial reading and writing skills that these students need. One of the biggest reasons they are put in there is because they can't read, they can't write, they can't compute. They can't do anything on an academic level. They are warehoused or babysat in a vocational education class. The reason they don't get a job afterwards is not so much because of what is wrong with the vocational education program as because they are simply another great part of our illiterate graduates. That is what has got to stop.

If we are to expand and move as technology brings about change, then people must be able to read directions, must be able to fill out the transfer papers required for all of these changes in jobs to make job applications, to solve simple, everyday kinds of problems, and, importantly, I think if nothing else, we should sit them down and teach them how to type. I think the world will use keyboard as time goes by since all men will have to do it and they don't like to be called typists.

They will need to learn to keyboard in order to operate.

Mr. MacKay. How about old females?

Ms. Vetter. Probably the same thing.

Mr. MacKay. As long as we are being unchauvinistic; old persons.

Mr. Almon. May I say that I keyboarded my testimony for you?

Ms. Vetter. And so did I.

Mr. MacKay. We can't keep them in school against their wills after they are 16. I have been involved at the state level with vocational educators who are trying to deal with that. If you offer occupational education and the whole idea of introductions to what it is like to be a productive, mature adult, if you offer that after age 16, you guarantee that your statistics are going to look pretty good, because the people that needed it aren't going to be there.

Ms. Vetter. That is right.

Mr. MacKay. How do you design a program?

Ms. Vetter. I have no answer for the people who will drop out because they can't make it, except if we did a little better job in our teaching system, we might be able to retrieve a great many more of them than we now do.

Dr. Almon. I wanted to add that the independent high schools I have been associated with, the Waldorf Schools, have found that in dealing with this problem, the arts and the crafts are extremely valuable. In these schools, painting, sculpture, gymnastics, dance, and handwork, craftwork, ironwork, and gardening play an important role and help to keep many of these students and provide abilities which can then be transformed and used usefully later. And it is a lot of fun.

I think that the State schools have generally given inadequate attention to the artistic programs and felt that the solution to the reading problem is just to work harder on reading. It may be more helpful to go and paint for a while.

Mr. MacKay. These schools have a pupil population which is representative of the society as a whole? How many ghetto kids do they have?

Dr. Almon. Well, the one in downtown Detroit has a substantial number of students who are there only because of scholarships. Of course, independent schools have to pay for themselves and you can't ask them to represent a full cross section. But you can take a cross section—you can take a segment economically of parents, and you find quite a wide cross section of problems of children. So they do have a pretty good range of problems.

Mr. **MacKay**. I think I understand what you are saying. As I would express that, you can tell which kids are going to drop out of school with about 90 percent accuracy by 6 or 8 weeks into the first grade, and you do that by knowing the characteristics of the family.

Dr. **Almon**. Yes.

Mr. **MacKay**. Is that kind of what you find?

Dr. **Almon**. Yes, though what I was saying is that you could find children of very successful parents who have all sorts of problems and who would drop out of school if there were not programs which attracted them and kept them in.

Dr. **Bendick**. I would like to add in all this mix of where public resources can be usefully put the so-called chapter 1 programs of the Educational Consolidation Improvement Act (which used to be title I of the Elementary and Secondary Education Act) which gives resources to schools dealing with large numbers of disadvantaged kids. This program has an outstanding track record in terms of innovative ways to help kids, starting all the way back in elementary schools.

Ms. **Vetter**. Which is where we need to start helping them.

Mr. **MacKay**. I heard a presentation last year to the Southern Governors Assocation by a man—I forget the university. It seems to me it may have been Michigan. He was doing longitudinal studies on early childhood education and the implications 20, 25 years later. He was still following the two groups. He was finding a startling improvement, like 50 percent less joblessness, 50 percent less crime and the southern Governors were trying to figure out how they could make that work in what they call a cost-effective way.

Would you agree with this? I don't know if I am asking a proper question.

Dr. **Bendick**. Those high levels of return on societal investment are, indeed, really there. Another example is the Job Corps where you are dealing with a population of high school dropouts, and the studies say that for every dollar that society invests in training in the Job Corps, you get $1.45 back in benefits. I wish I could invest my money at that rate.

Mr. **MacKay**. That is correct.

Ms. Vetter, I felt that you were saying something different in terms of the implications of technology on employment later on, on unemployment, than perhaps some of the other panelists. Perhaps it would be well if I asked each of you to comment on the other's testimony. Are you in agreement? Do you perceive you are in agreement or disagreement?

Ms. **Vetter**. I don't know what they may or may not feel. Jobs created by technology will not equal jobs destroyed by technology, otherwise technology has not served its purpose. It is to make things far easier to do requiring less physical labor on the part of individual people. So certainly if you transform the automobile industry into a robot industry, the number of people required to operate the robots and to maintain them will be far fewer than the number that used to be on the production line.

Dr. **Almon**. That is certainly correct. That point was in my testimony also. The complement of it is that transformation means that automobiles are cheaper, that purchasing power generally is increased, that we can have our automobile and have more left over to spend on education, better medicine, and services of all kinds. When we take that into account, we see the technology does not, in the aggregate, create unemployment. Although, as Ms. Vetter has said absolutely correctly, it is not in the high tech industries that the additional employment comes primarily.

Ms. VETTER. One of the questions we were asked to consider on this panel was will this add to or take away from the pool of chronically unemployed. I think there is no question it will add to that pool because these are the people who don't even have the skills to work in today's world, and they are certainly not going to get the skills that are required to work in tomorrow's.

We will add to that pool people coming off the production lines who are unable, unwilling, or not given the opportunity to learn how to do something else that is in demand, whatever it is.

Mr. MACKAY. So the pool of high-risk people whom—I think you all are saying—our secondary vocational programs are not serving now, that pool will get larger. So, if we targeted in on a problem that is clearly going to be a complement—or it is going to come out of advanced change, advanced technology, trying to deal with the problems of that pool would be a problem that would be greater, more intense?

Ms. VETTER. I think so.

Dr. ALMON. I think so, too.

Mr. MACKAY. I asked a half-baked question to Mr. Lund. That is, a policy that would appear to bring America through this well, does that solve a long-term world problem or does that intensify it? I would like to get your response, because your model seems to be the same as his hypothesis which is we can just make it change faster, reduce the friction costs of change in America. If we can, the labor factor in the total costs will go down. We will become more competitive.

There is apparently no downside to that in that someone else has become less competitive. I wondered, have you given any thought to what are the implications if all the countries in the world adopt our policies? Is this not the same as all the computer-driven models in the world which led to 26,000 motel rooms in Orlando at the same time and they all went broke?

Dr. ALMON. It is interesting that when you asked that question earlier I said to myself, what will I say when he asks me that.

I do not think that we would be exporting our problems. I would point out that as we become wealthier, because of technology, we import more. In our scenario, imports are up. Foreign travel is up. We will want more of the goods of other countries. So we are definitely not exporting an unemployment problem. Furthermore, I think the kinds of things which we have been talking about here in the last few minutes—about a secondary education that aims at more versatility rather than rigid training for a particular function—we would be very happy to see done throughout the world and to see people become less protective of exactly what they are doing because they know that they easily can do other things.

Mr. MACKAY. You are basically saying that vocational education includes reading, that is reading, writing, computation?

Dr. **Almon**. That is the primary, fundamental vocational education.

Mr. **Bendick**. I wanted to respond to your question by saying that today, yesterday, and tomorrow all the labor markets, all the nations of the world are interconnected commercially, and that as technology draws one of them up, it will draw all of them up. That is really the basic promise of technology, which is why it is good news for both the United States and nations overseas.

Ms. **Vetter**. I agree with that. I simply think that we add to a problem we already had if we don't do something about seeing that the educational level—not the training level, the educational level—of the people coming out of our school system is such that they are then amenable to and able to be put into training programs at different times at any age. I am not too old to learn how to run a computer, but a lot of people my age are because they don't know how to read, they never had any math background. That has to do with my education, not my training.

The level of education that we are producing in our non-college population, and I must say in some of our college populations these days, is such that they are not amenable to switches as changes come about in the economy and in the needs for workers that will require such switching.

I think, too, that just as we have seen the underdogs revolt in this country, whether it was blacks or even women, we will also see that with the chronically unemployed as that group gets larger and more dissatisfied. It may get more vocal, more angry, and perhaps more dangerous in addition to being a drain on society itself—both envious of and angry at that portion of society that can make its way.

Mr. **MacKay**. That is fascinating. It has been a very productive meeting and a very productive panel. I want to express the appreciation of all of us for your participation. You have the scary thought every now and then that if we stay here long enough, we may actually learn something.

The next hearing in this series of hearings will be held Friday at 9:30 a.m. in room 2318 of this building and the topic will be demographics.

I would like to thank you all again for participating. Before we get thrown out, we are adjourned.

[Whereupon, at 12:55 p.m., the subcommittee and the task force adjourned, to reconvene at 9:30 a.m., Friday, June 10, 1983.]

TECHNOLOGY AND EMPLOYMENT

FRIDAY, JUNE 10, 1983

House of Representatives, Committee on Science and Technology, Subcommittee on Science, Research and Technology, and the Committee on the Budget, Task Force on Education and Employment,
Washington, D.C.

The subcommittee and task force met, pursuant to call, at 9:30 a.m., in room 2318, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Present: Representatives Walgren, Dymally, and Bateman.

Mr. Walgren. Let me call us to order and open this third day of hearings in the area of technology and employment held by the Subcommittee on Science, Research and Technology, together with the Task Force on Education and Employment from the Budget Committee, chaired by Congressman Dick Gephardt.

Congressman Gephardt is unable to be here today, but we are in the process of making a record which we hope will serve as a resource for other members to consider the problems raised in this area.

The nationwide jobless rate that is at literally record levels, understated in every measure that we have in our society because there are so many discouraged potential employees that are no longer seeking work, drives the Congress in this area. We are in a time in our economy when the very existence of some of our basic industries is being questioned.

In the steel industry, levels of employment over the last 25 years have fallen from 700,000 to somewhere in the range of 200,000, during a period when there was substantial modernization in the steel industry as measured by the fact that the actual production has not fallen that much, but the employment has, which means that there was increasing productivity. Nonetheless, the industry is under tremendous pressure from abroad. And when employment diminishes so completely in that kind of industry, you wonder what that foretells for other industries.

If we broadly reduce our employment by the levels that the steel industry has reduced its employment, there is going to be very little activity to support the many things that, as Americans, we have to do together.

This all comes at a time when international competition is strengthening in a way that challenges our ability to compete. There were times when the United States had literally monopolies in the modern production of manufactured goods. But when you look around the world after the 1970's, that is clearly not the case.

And that is particularly difficult when other countries have an incentive because of the strength of the dollar, their need for the dollar, to target markets in our country, and subsidize in some direct fashion their production in those areas delivering goods which we cannot in our own economy compete with.

This comes at a time when our educational system is certainly not performing as well as we would like and when the whole technology of work is changing so rapidly that our work force is going to have to keep up at a pace that we have not had to in the past if we are to succeed.

So, these are times of great stress and great challenge and great opportunity for the U.S. economy. We will only succeed if we proceed as wisely as we can, taking those steps which we can to lessen the damage that is done by the changes that will occur and take those steps that will maximize the opportunities that these changes do present to our society and to our people.

With that, I would like to recognize the members for any opening thoughts and then we will proceed directly to the two panels of witnesses today.

Let me recognize Mr. Bateman first, and then Mr. Dymally.

Mr. **Bateman**. Thank you very much, Mr. Chairman.

I suppose it may have something to do with the fact that it is Friday, but I am going to confine the opening remarks that I have to something very brief.

Let me say that I think it is a very worthwhile and meaningful opportunity for those of us in the Congress to hear the distinguished witnesses who are coming before us to discuss our state of technology as it relates to the employment scene in the country.

We recognize that our economy and the way it works, how, and at what people work, is certainly going to change. We are interested to know whether or not there are new phenomena that are much different from the types of technological displacements that we have seen in our past history.

We are certainly, all of us, very concerned about the level of unemployment in our country. Certainly all of us want to do that which Government can best do, legitimately do, that will have a positive impact upon our unemployment problem.

There are things perhaps that we in Government, here in the Congress, can do that could be as destructive as constructive, and certainly I am sure all of us want to have the best advice and thinking that is available to us in determining how much and how little, what or what not, public policy as shaped by the Congress can do to be contributory.

Certainly all of us appreciate the willingness of our witnesses to come before us. I would only add to what has been said, that is the fact that I am sure that our missing colleagues would like to be here, but it is a difficult day for many of them in terms of their schedules and commitments, and I would certainly hope that they will attend to the written record which will be made by our witnesses today in their presentations.

Thank you, Mr. Chairman.

Mr. **Walgren**. Thank you, Mr. Bateman.

Mr. Dymally.

Mr. **Dymally**. Thank you very much, Mr. Chairman.

First, I want to commend you and the committee for conducting these hearings and raising a number of questions which this Congress must answer at some subsequent time.

One phenomenon I have noticed recently is the movement of members of ethnic minorities from the inner cities to the suburbs. This is sometimes accompanied by a movement of nonminority groups into the inner city, as occurred in the District of Columbia. And the question I would like some of the panelists to touch on is, does this movement have any implications in terms of the work force?

Also, in keeping with that theme of migration patterns over the past few years, we have seen a great deal of industry moving to the South. That is another question it seems to me that we need to ask.

Then I would like to project a little farther and look ahead and see what effect is this migration having on the workplace.

Mr. Chairman, I would prefer to hold back, to ask these specific questions of the panelists. I thank you very much for this opportunity.

Mr. WALGREN. Thank you, Mr. Dymally.

Let me call our first panel to the table.

Audrey Freedman, a Labor Economist with the Conference Board; Robert Hall, a Senior Research Associate with the Bureau of Social Science Research, Inc., and Russell Rumberger, Research Economist, Institute for Research on Educational Finance and Governance of Stanford University.

I want to welcome you to the committee. Your written statements and any supplemental statements that you might be interested in submitting to the committee will be incorporated in the record as a matter of course.

In the interests of keeping the discussion moving, we do have a timer there, and we would like to shoot for a 10-minute presentation, or not much longer than that. The red light will go on at 10 minutes. Don't feel that that means you must stop immediately. But it is true that we do have to keep moving in respect of the time of others.

So with that, let me invite you to make your presentation in the way that you communicate what you feel is most important.

Let's start in the order that we came to the table, with Ms. Freedman first.

[The biographical sketch of Ms. Freedman follows:]

AUDREY FREEDMAN

Biographical Sketch

Audrey Freedman is chief labor economist at The Conference Board. After receiving her B.A. in economics at Wellesley, Mrs. Freedman was a research assistant at the Graduate School of Public Administration at Harvard University.In 1960, Mrs. Freedman joined the U.S. Department of Labor. She published a number of studies of technological change and its effects on manpower and skill requirements, as well as the response of union organizations to changing conditions within industries. From 1967 through 1970, Mrs. Freedman managed experimental projects that relocated workers from depressed areas to growth centers in 38 states.

During Phase I and II of President Nixon's economic controls, Mrs. Freedman was with the Cost of Living Council and the Pay Board, in policy development. Immediately prior to joining The Conference Board, she was with an industrial relations consulting firm.

Mrs. Freedman is the author of three books and numerous articles covering a wide variety of subjects in the human resource field. Her articles have appeared in university business journals such as the Harvard Business Review, conference proceedings, and government reports. Mrs. Freedman is a consultant to the Commerce Department, U.S. Bureau of Labor Statistics, and the Congressional Office of Technology Assessment, as well as to businesses and industry associations.

STATEMENTS OF AUDREY FREEDMAN, LABOR ECONOMIST, THE CONFERENCE BOARD; DR. ROBERT B. HILL, SENIOR RESEARCH ASSOCIATE, BUREAU OF SOCIAL SCIENCE RESEARCH, INC.; AND DR. RUSSELL W. RUMBERGER, RESEARCH ECONOMIST, INSTITUTE FOR RESEARCH ON EDUCATIONAL FINANCE AND GOVERNANCE, STANFORD UNIVERSITY

Ms. **FREEDMAN**. Chairman Walgren and members of the subcommittee and task force, thank you very much for giving me the opportunity to discuss the demography of the work force in the next 10 to 20 years.

This is a period of abundance in our work force. And I think that needs to be appreciated. We at the moment are focusing on the pathology of unemployment because it is very high. That leads us to think of the work force as a collection of social problems. This is unfortunate.

Yes, unemployment is a problem because it represents a loss of the output of producers in the society, producing people in the society. And it also forces dependence upon people who prefer to be self-supporting. But it is unfortunate when we begin to think that the labor force is a collection of social problems rather than an abundant resource that needs better employment and better allocation to work.

This is a productive resource, our work force, that responds to incentives and disincentives.

In the period 1970 to 1982 our work force grew by 27 million people. Responding to incentives, it grew faster than the population. The proportion of nonworkers to workers fell. In 1965 there were 1½ nonworkers for 1 worker. Now that dependency ratio is just a bit above 1, and it will stay around 1 until the end of the century. In other words, we have a very high proportion of supporters to dependents in the work force, and we are blessed by this for 20 years or so.

More adults than ever are supporters. The proportion of adults who are working, who are in the labor force was 61 percent in 1970. Now it is 64.3 percent. That also is an all-time high.

This is largely due to the increasing participation of women in the work force. In fact, since this data series began in 1940, women's participation in the labor force has been rising—ever since 1940. It is now about 52–53 percent.

Participation rates for men have been gradually falling since 1951, when they were 87 percent, to about 76–77 percent now.

During the rest of the century women's participation will continue to rise, perhaps at a somewhat milder pace. And since the black and Hispanic population increase will continue to the end of the century, faster than the white population, and its participation rates overall are not expected to change, we can describe the labor force at the turn of the century as being more female, more black, and more Hispanic.

It is time now to call the baby boom the prime age boom. The baby boom is now clustered around the age of 30. It is a labor force abundance situation because this is an educated group, a work-experienced group by now, fully assimilated into the labor force, especially adaptable to job change and industry change, to "moving on." It is a flexible resource right now, particularly because of the age distribution. And it is an asset to be more efficiently employed as industry technology, structure, and production changes.

Family relationships, family stability and dependency are bound up with the labor force activity in this economy. In the period 1970 to 1980, family size fell. In 1970 average family size was 3.11. Now it is 2.75. This is mostly due to an increase in single persons living alone: people not yet married, people who are divorced, people who are widowed. Also, there are fewer children per family. But that is not the main cause of the decline in household size. Married couple households grew more slowly in this decade than other kinds of households.

In two-parent families, both parents work, and that is very much a recent development. It is something that alters the unemployment picture. When one breadwinner loses his or her job, the other breadwinner is more likely to be employed.

Families maintained by women alone have increased enormously. In 1970 there were 6 million such families. Now there are 10 million families maintained by women, 15 percent of all families—and among black families, 40 percent of families are maintained by women.

This is a labor force that is very responsive and not tradition-bound. It is highly mobile compared to other labor forces around the world. Especially mobile are the 20- to 25-year-old people, and those who are single. Families are less mobile, because there are dependents to be considered and there are family investments in localities.

In my statement there is a reference to experimental labor mobility programs that I managed in the Labor Department in the late 1960's under the Manpower Development and Training Act. We learned some things from those labor mobility programs. One of them was that trying to help people to move to jobs that had moved elsewhere was most effective when it was focused on young single people and least effective when it was focused on family people—and least effective of all when it was focused on people who had been laid off after working in an industry for many years.

Some projects, operated in shrinking industry, plant-closing situations. We sent in people to find jobs for those workers elsewhere and to relocate them, and got very, very few acceptances—because they were older, they had homes, they had communities, they were accustomed to high wages, they were accustomed to the industry practices where they had been working. In fact the last thing they wanted to hear just before the plant closed was "We can find you a job elsewhere."

Perhaps that changed later. But let me say that it was not a very good proposal from their point of view, just at the time they were losing a lifetime job.

When the size, structure, and technology of industry is changing rapidly, mobility is an adaptive technique that must receive a great deal of attention by the Government, and added support. In addition to geographic mobility, industrial and occupational mobility must also be encouraged.

Again, the prime age boomers that we have in abundance are most adaptable to this kind of change, if it is not discouraged by various kinds of public policy.

Training for specific jobs in most industries is provided by employers. But the employer from his point of view overinvests to the degree that the people that he has trained take jobs elsewhere. This is something that needs to be kept in mind because it deters industry from making major investments in broad skill training.

When the unemployed steelworker, applies for a job in another industry, he is going to be viewed as an unskilled applicant. An applicant who needs to be trained fully into a new job. An unskilled applicant will be offered perhaps $6 an hour—and he is accustomed to $20 an hour. This is a great difficulty for unemployed, middle-aged, ex-industrial workers.

Employers cannot be expected entirely to make up the training gap. Unless displaced industrial workers invest in further education and technical training themselves or find a place in the limited State and local training programs, they will be forced into a more and more competitive market for unskilled labor.

Withdrawal from the labor force has become a problem. Right now in the first quarter of 1983 there are some 1.764 million people who have withdrawn from the labor force. This is the so-called "discouraged worker." They are not looking for work because they don't think they can find work.

Now as payrolls begin to increase, these discouraged workers will begin to look for work again. In other words, they will become unemployed. This is one of the reasons the unemployment rate may stay high for some months to come. But the recession will also leave a lot behind permanently. In some cases alternative income sources exist: early retirement pensions, disability retirement, off-the-books employment—and temporary income sources: regular unemployment insurance, extended benefits, Federal supplemental compensation, Trade Act benefits, employer-paid supplememtal unemployment benefits, and severance pay.

All of these ease the dislocation for industrial workers, but they also provide incentives not to work. They pull people, or they keep people out of the labor force, because in easing the way out they can delay for some time an individual's reentry and redevelopment of his own resources.

This early departure effect has been particularly strong for men age 55 to 64. In 1959 to 1970, their labor force participation rate declined just a little bit, from 86.9 to 83 percent. But then from 1970 to 1980 it fell sharply to 73 percent and it is falling more today. It seems likely that that will continue.

We need to reexamine our income support systems to make sure that they are not keeping people out of the labor force, instead of encouraging readaptation and flexibility and reentry—so that it is not a permanent loss for a middle-aged man to lose his job.

Perhaps the simplest way to describe the male/female shift in the work force now and for the next decade is to say that more and more women are working for more and more of their lifetimes; while nearly all men work, but for shorter and shorter periods of their lifetimes.

In spite of an increasingly crowded labor market, we also have a flow of what are known as illegal immigrants or undocumented immigrants. It is important to remember these are people immigrating to a job. Various estimates were produced in the late 1970's of this unknown quantity; they ranged from 3 million to 6 million. So, perhaps 6 million additional people are currently employed in the economy. This means that the unemployment rate may be somewhat lower. I calculate perhaps 9.6 percent—if we were able to count all of those employed but not recorded as employed.

The logical place to control this immigration is at the point of hiring, and in fact, I believe the Senate has already passed and the House is considering a bill to do this. It is interesting that the Reagan administration, in spite of its emphasis on decontrol and noninterference with business, has supported the legislation. If it passes, the matter of immigration into a job becomes an enforcement matter. But I don't think that it will entirely suppress illegal immigration because the incentives to hire this kind of worker and the incentives to come into the United States to get a job are still very strong.

There are two reports that I have made available to you that relate to what this committee is discussing. They concern Japanese investment in U.S. manufacturing facilities, and a survey that we did of Congressman, Senators, and Governors to find out if Japanese investment is welcome, what kind of industry you would like to see the Japanese developing here, and what benefits you see.

The main benefit cited by all respondents was jobs—that this capital inflow would create jobs. A second benefit was the technological development of our economy; and third some new management techniques that might be brought in by the Japanese. The other report describes some work force management techniques that the Japanese are bringing in.

When asked which industries elected officials wanted the Japanese to come into, the response was heavily in favor of high technology industries. Very few were service industries. In fact, that accords with what is happening. Capital-intensive industries are attracting foreign investment, not labor-intensive industries. So there will not be a great deal of job creation.

[The prepared statement of Ms. Freedman, and attachments, follow:]

Testimony of
Audrey Freedman
of The Conference Board
before the
House Committee on Science and Technology,
Subcommittee on Science, Research and Technology
and the
House Budget Committee
Task Force on Education and Employment
June 10, 1983

Chairman Walgren, Chairman Gephardt, and Members of the Subcommittee, thank you for giving me the opportunity to describe the American workforce -- productive Americans -- of today and the rest of this decade. We are beginning a period of abundance in our workforce that must be appreciated for its potential contribution to the nation's economy. An exclusive focus on the pathology of unemployment can lead to perceiving the labor force as a collection of social problems. Certainly unemployment is a problem for two main reasons: it constitutes a permanent loss of the output of unemployed producers, and it forces dependency upon people who prefer to be self-supporting contributors to society.

But the labor force is not a bundle of social problems. It is an asset, a productive reasource that responds to incentives and disincentives to work -- and to invest in training, education, health, mobility, and job search itself.

The U.S. workforce grew by twenty-seven million persons between 1970 and 1982 -- much faster than the population. This means that the ratio of non-workers to workers (the dependency ratio) in our society has been steadily falling from about 1½ in 1965 to slightly above 1 today. Until the end of this century, we will be experiencing a very low dependency ratio: about one non-worker for each member of the American labor force.

At the same time, more adults than ever are supporters. The proportion of adults in the labor force grew from 61 to 64.3 percent between 1970 and 1982, largely because of the increasing participation of women. In fact, women's participation in the labor force has been increasing since the current data series began in the late 1940s, and is now about 52-53 percent. Men's participation rates have been falling gradually since 1951 (when 87 percent of adult men were in the labor force) to a current level of about 76-77 percent.

During the rest of this century, women's participation is expected to continue rising. Since the black and Hispanic population is growing more rapidly than the white, and group participation rates are not expected to shift, the labor force will be more black, more Hispanic, and more female by the end of the decade.

It is time, now, to begin calling the baby boom "the prime age boom." Clustering around the age of thirty, this group creates some of that labor force abundance that I mentioned at the start. It is educated and by now work-experienced. For several reasons that will be cited later, the prime age boomers may be especially adaptable to job change, industry change, -- to moving on. Their flexibility is an asset to be employed, not discouraged.

Family relationships, stability and dependency form a complicated interconnection with labor force changes. During the decade 1970-80, family size fell from 3.11 persons per household to 2.75. Much of this drop is due to an increase in single persons living alone (before marriage; after divorce; in widowhood) and in smaller part, to fewer children per family. Married couple households have grown more slowly than other kinds of households for decades. However, the prime age boom of the 80's may stabilize the shrinking household -- or even increase it for awhile. One strong trend will continue: in two-parent families, it is more and more likely that both will be in the labor force. This alters the consequences of unemployment for intact families, because job loss is not likely to affect both parents simultaneously.

Another element of the family dependency shift is the growth of families maintained by women, from under 6 million in 1970 to about 10 million today. Women are currently supporting 15 percent of all families (and 40 percent of black families).

Adaptation to the Labor Market

Our labor force is very responsive to economic signals. It is not tradition-bound. Thus, Americans have been highly mobile, especially in search of work. Mobility is much higher among 20-35 year olds, and among those with no dependents. In fact, when I directed the labor mobility experimental manpower programs in the Department of Labor during the late 1960's, we found that job placement and mobility assistance (mostly for job search in specific labor-shortage areas) were best focused on young single people. Older family heads were less likely to accept a distant job offer and had more difficulty (and more expense) in making the adjustment to a new area. One of the reasons, of course, is that the family heads had greater investments and social ties to their homes that -- even though they could not be measured fully by economists -- deterred them from making distant job searches. Least effective of all these mobility programs were those that focused on displaced workers in plant closing situations in the industrial heartland. The workers were beyond the age of easiest relocation, had homes and families and community bonds of great strength, were accustomed to a relatively high wage and to a particular industry's practices. When such workers were offered relocation assistance as the plant was closing or soon after (on the theory that any unemployment would thereby be averted) they rejected it in favor of a local job search -- often in a labor surplus area.

When the size and structure and technology of industry is changing rapidly -- as it is today -- mobility is an adaptation technique that must receive particular support. Not only geographic mobility, but also industrial and occupational mobility. Growing and revitalized industries with strengthening labor demand are going to have skill requirements and occupational structures that are distinctly different from declining industries. Here again our "prime-age boom" is beneficial. This large group is at an age where training and retraining will pay returns for several decades. It is at an age more receptive to change and to market incentives. It is also well educated compared to predecessor generations.

Training for specific jobs is in most industries provided by employers to the degree that it relieves their own labor shortages. Even here the employer overinvests, from his point of view, when some of his trained workers leave for jobs elsewhere. Among production workers in some of our older and shrinking industries, however, training has been minimal. A displaced auto assembly-line worker, foundry worker, steelworker is likely to be "unskilled labor" to another employer. As such, he goes to the rear of a hiring-and-training queue, especially if his wage demands exceed those of other potential trainees.

Unless displaced industrial workers invest in further education and technical training themselves, or find a place in the limited state and local training programs, they will be forced into the more and more competitive market for unskilled labor.

Withdrawal from the labor force is also a response to incentive (or disincentive) signals from the labor market. With a national unemployment rate of 10.2 percent in the first quarter of 1983, there were some 1,764,000 people who were not looking for jobs simply because they expected a search to be fruitless. Now as payrolls begin to increase, these discouraged workers and others who were not looking for jobs will reenter the workforce -- that is, they will become unemployed by seeking work. (This is why the unemployment rate may not fall as fast as payroll jobs increase.)

But recession will leave a lot behind. Combined with bankruptcies, permanent reductions in industry size, lowered labor needs due to new technology, the recession has retired many from the labor force who are unlikely to return. In some cases, alternative income sources exist: early retirement pensions, disability retirement, "off-the-books" employment. Temporary income sources also exist: "regular" unemployment insurance, extended benefits, Federal Supplemental Compensation, Trade Act benefits, employer-paid supplemental unemployment benefits in some declining industries, severance pay.

All of these payments ease the dislocation for the older worker. But they have another effect that social provider thinking overlooks: income flowing from non-work creates some incentives not to work, not to adapt to change, not to retrain. It creates incentives that pull people out of the labor force when they are "pushed" by the loss of a particular job. Early withdrawal from the labor force creates unnecessary dependency.

This early departure effect has been particularly strong for men aged 55 to 64. From 1950 to 1970, their labor force participation rate declined moderately from 86.9 percent to 83 percent. Then it fell sharply to 73 percent by 1980. Unfortunately, it appears likely that the decline will continue. In the face of an oversupply of labor and pressure to create positions for younger workers, we will continue to push out older men early. Age discrimination plays a part as the middle-aged worker who loses his job is less likely to be hired by another firm. Public policy against age discrimination is not enough to overcome the pressure to "ease out" older workers. We should be examining our income-support systems to find designs that encourage re-adjustment and continued participation in the labor market of middle-aged men whose continued employment is threatened by the need to change.

Perhaps the simplest way to describe the male-female shift in the workforce now (and perhaps for at least the next decade) is that more and more women are working, and for a greater portion of their lifetimes; while nearly all men work -- but for a shorter and shorter portion of their lifetimes.

In spite of an increasingly crowded labor market and high unemployment rates in the past several years, the United States is an attractive labor market to immigrants, especially from Mexico and South America. The inflow of most immigrants is "undocumented" and uncounted. Estimates made in the late 70's placed undocumented immigrants at between 3 and 6 million, at that time.

It is well to remember that a job in the U.S. is what draws these immigrants. So, there are probably 3-6 million more employed persons than the one hundred million that we officially estimate each month in the Current Population Survey. Among other things, this suggests that the civilian unemployment rate in May might be as low as 9.6 percent, rather than the estimated 10.1 of our measured and counted labor force. It also suggests our indicators for detailed characteristics, such as young Hispanic men, are "off" to a greater degree than the overall employed totals.

The logical place to "control" this immigration is at the point of hiring. And, with high unemployment in the early 80's, increasing public approval of such controls was foreseeable. Even the Reagan Administration, with its emphasis on decontrol and non-interference with business, has supported legislation to make it an offense to employ undocumented aliens. If the legislation is passed, the issue of immigration into our labor force becomes an enforcement matter. But the numbers of uncounted employees may not substantially change. Incentives to find work in the U.S. are still strong; employer incentives to hire aliens may be only somewhat diminished.

Industrial and Occupational Shifts

It is by now conventional to observe that "service industries" are growing faster than manufacturing. I will avoid this convention, but raise some points about particular industries that may be overlooked in the larger (and vaguer) context of the service shift. The Bureau of Labor Statistics (BLS) uses the terms Service-Producing Industries and Goods-Producing Industries. Among the latter are classed agriculture, mining, and construction, in addition to manufacturing.

In the next ten years, the BLS model predicts a continuing decline in agricultural employment from today's level of 3.3 million. Output in this sector will continue to increase. Over the years of our lifetimes, this part of our economy has undergone the most thoroughgoing and constant technological change, productivity advances, structural change, and worker "displacement" of any sector. It now employs about 3 percent of the workforce. Toward the end of this century, when the workforce is still smaller, biotechnology will begin to affect agriculture.

Mining was the technologically-transformed industry of the 50's, and the shrinking industry of the 60's. Then in the 70's it grew rapidly in employment, due primarily to increased oil prices and increased world prices for other mineral resources. This industry, also, has undergone waves of change and employment shifts that have attracted relatively little notice. Today, it employs about a million workers, about 40 percent of them in oil and gas fields. The BLS projects employment growth of between 20 and 30 percent by 1990.

Construction employment, now at a depressed level of about 3.9 million, is expected to increase to 5.6 to 6 million by 1990.

Employment in manufacturing, the largest "goods producing" sector, grew very slowly during the 70's and has shrunk ten percent during the recession years. Nevertheless, the BLS expects employment to grow to between 23.3 and 25.3 million by 1990. The Bureau based this estimate on a defense build-up and "greater emphasis on investment goods" in this decade. However, the recession has depressed capital expenditures by businesses for several years now, so the amount of additional employment the Bureau attributes to a business equipment boom has not yet begun. In fact, capital goods sectors are still not gaining orders -- are still depressed from their 1980 levels. For this reason, growth projections may be revised downward.

Service-producing industries (which might more significantly be called "producers of intangible goods") encompass

- public utilities
- communications
- transportation (airline, rail, trucking, etc.)
- retailing
- finance (banking, insurance, etc.)
- health care
- government and protective services
- education

a wide stretch -- and not what the word "service" usually brings to mind.

Overall, these intangible goods-producing industries lost no employment during the recession years. So the BLS projection of an increase from 65.7 million workers in 1980 to 78.7-83.5 million in 1990 does not have to catch up on declines due to the recession.

Employment growth will differ greatly among the industries producing "services." Relative size and growth projections are shown below:

Industry Sector	Millions of Jobs	
	1980	1990 (range)
transportation, communications, & public utilities	5.5	6.5- 7.1
retail & wholesale trade	20.6	25.1-26.8
finance, insurance & real estate	5.2	6.5- 6.9
other services	26.2	31.6-33.5

(Adapted from testimony of Ronald E. Kutscher, Associate Commissioner, Bureau of Labor Statistics, before the House Subcommittee on Oversight and the Economy, May 18, 1983.)

It is in some of these intangible goods-producing industries where technological change may be the most rapid during the next decade. Computer and communication integration will take place in such industries as finance, food and other retailing, the communications industry itself, medical services, and many business services. Computer integration can reduce labor requirements, but the greater effect may be the restructuring (and relocation) of the service industries it "automates." Far from simply replacing workers by doing the same tasks electronically, computer/communications systems can essentially change the product of an industry and change the nature of competition thereby. From these effects, employment consequences flow.

Even the most capital-intensive service industries (pipelines, railroads, broadcasting, electric & gas utilities, water & sanitary service) may experience a quickened pace of change in the coming decade. And among the more labor intensive, one can find industries where computer/communications systematization may alter the industry drastically -- hospitals, other medical services, postal service are some examples.

It is interesting how the official definitions of industries (the Standard Industrial Classification Code) veer toward a product-based taxonomy. When technology affects process, but also transforms the product, such industry groupings get in the way -- and they are always "behind the times." An example of this problem can be found in the growing computer-involved networks for exchange of information, disseminating data and text to subscribers, conducting research, holding conferences among distant participants. Now the industries for locating these activities in the BLS Industry-Occupational Model (after the Standard Industrial Classification Code) are these:

Telephone communication
Telegraph communication
Radio and television broadcasting
Communication services not elsewhere classified.

Technological advances have changed the product -- the service -- entirely, and we have no place to classify the result, let alone measure the employment created, shifted, or extinguished.

The Effects of Japanese Investment in the U.S.

Since I am testifying before Congress three days before release of a Conference Board survey of Congressmen -- on a subject that relates directly to your hearings -- I would like to describe the survey briefly.

We asked Congressmen with at least one Japanese-owned manufacturing plant in their districts, Senators and Governors the following four questions:

1. Do you think a Japanese business presence is beneficial to the economy of your state?
2. What are the benefits or drawbacks?
3. Would you like to see more capital investment by Japan in your state -- and if so; in which industries or sectors in particular?
4. Do you think direct investment from Japan helps reduce trade conflict?

Nearly every respondent replied that added employment was the main beneficial effect of Japanese manufacturing here. About one sixth of respondents volunteered technology transfer to the U.S. as a benefit. Almost a quarter suggested that the Japanese would bring in new production management or business techniques. The nature of replies suggests that elected officials take a social-service view of such investment, not a technology or productivity-boosting view. And yet, in volunteering the specific industries in which they would like to see more Japanese development in the U.S., one third gave "high technology" generally. Others specified such industries as electronics, biotechnology, robot production, etc. A total of only 7 suggested service industries.

The results of this survey are available to you in the report "Japanese Investment in the United States: an Opinion Survey of Elected Officials." Advance copies are here in the Committee room. It is a companion to our earlier conference report on "Japanese Management of U.S. Workforces," which describes the Japanese management and training innovations being introduced here. We plan to continue with a study of Japanese and other foreign investment in six specific industries, with special focus on employment and technological effects.

The Disappearance of Manufacturing

Overwhelmed by the loss of competitive advantage, and by the recessions of the 80's, people sometimes ask, "Is manufacturing going to disappear in the U.S.?" There are two reasons why manufacturing will not disappear from this country. One of them is the effort to install new technology -- the robots, microprocessor-directed and computer-controlled production systems, and genetically-engineered biological "processors."

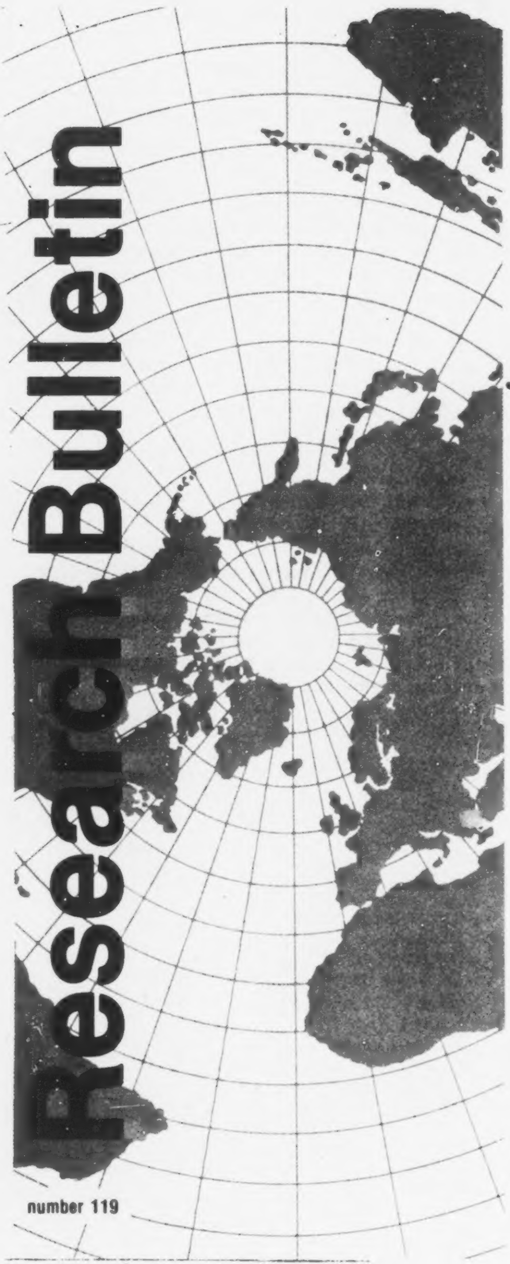
The other is our resource base. It makes little sense to ship raw materials elsewhere for processing and manufacturing, then import the final product back. It makes no sense unless we are so inefficient that we cannot use our own resource base effectively. In the study referred to earlier, we note

> "A broad resource base alone will not 'create' manufacturing jobs. It is necessary that U.S. processing and fabrication using those resources be sufficiently cost-efficient to retain the comparative advantage through the stages of manufacturing. If 'made in the U.S.A.' means poorly made or expensively made, then Japanese (and others, including Americans) will invest in manufacturing facilities located elsewhere."

To say that resources can hold manufacturing here -- if we manage efficiently and employ advanced technology -- is not to say that manufacturing will continue to employ one-fifth of our workforce. The more advanced technology we install to retain manufacturing here, the more labor savings will follow.

At the turn of the last century, some 38 percent of American workers were in agriculture. By 1929, this had fallen to 22 percent. Now, it is about 3 percent. Yet our farm production has soared. In fact, U.S. food production, especially grain, is our strength in exports.

With increasing efficiency and investment in advanced technology, our manufacturing could grow by the end of the century -- yet employ only a tenth (or so) of the workforce. What needs to be done is not retard this development but speed its way. And, at the same time, direct the productive hours of the labor force to other outputs that are needed. Among these are capital investment in public facilities. (I do not define armaments as public facilities.) In the society that is developing, with large proportions of people living alone, people-care is the essence of growing industries. Today's examples are medical services, protective services, education, and such growing industries as food and restaurants. This is a service-employed economy, with its manufacturing accomplished by a very small workforce of technicians.



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Japanese Management of U.S. Work Forces

by Audrey Freedman

The Conference Board

Japanese companies operating in the United States are dealing with their American workers in some unconventional ways, and placing great emphasis on employee development and management. Labor is of crucial importance to these firms, according to a recent survey of 238 Japanese manufacturing operations in the United States. By their own report: "Success in this area is the key to an operation's overall success in the United States."[1] As of late 1981, the Japan Economic Institute reported that there were 272 Japanese manufacturing operations in the United States, employing 67,000 Americans.

In April, 1982, The Conference Board, in cooperation with the Japan External Trade Organization, held a conference on Japanese Management of U.S. work forces. At the meeting, representatives of several of these firms described specific measures they are taking to develop a trained, diligent and involved work force. This report draws upon their presentations and the discussions that followed.

As more and more Japanese firms open U.S. manufacturing plants, some of our imports are shifting. The United States still imports autos and microchips, cameras and television sets from Japan; but with growing U.S.-based fabrication, we are also importing:

- capital
- production systems
- product design and engineering
- quality standards and tolerances
- technological innovation
- management approaches and practices

The Japanese firms are combining their capital, management know-how, and technology with U.S. natural resources and labor force.

Mr. Takao Tominaga, Chief Executive Director of the Japan Trade Center, opened the conference with a description of this direct investment:

> "Although a relative latecomer, Japan's direct investment in the United States has grown at a remarkably rapid rate. During the seven-year period from 1973 to 1980, Japan's investments in the United States grew from a mere $152 million to $4.2 billion dollars. Japan's share of total foreign direct investment in the United States grew in this same period from 0.7 percent to 6.4 percent. While Japan still trails the Netherlands, the United Kingdom, and West Germany, its share already exceeds that of Switzerland and France.
>
> "It brings many tangible benefits to the recipient country: new jobs, ripple effect, and, in many cases, transfer of technology and know-how. It also aids in making possible the expansion of bilateral economic activities without the danger of trade frictions. One additional advantage of direct investment is that, by exchange of personnel and introduction of new management styles, it promotes the two-way cultural and human understanding that is essential to the healthy development of our bilateral relationship."

In answer to the overall question of management style, Mr. Tominaga reported from the JETRO survey that a number of "Japanese-type" practices appear to be fairly common. These include:

— Frequent meetings to gain employees' understanding of company goals and to improve communication and morale;

— Introduction of suggestion systems and quality-control procedures;

— Emphasis on work flexibility as a means of motivating workers and raising productivity;

— Somewhat greater company expenditures on recreational activities than is typical of U.S. firms.

A conscious effort to avoid layoffs was also evident: Many firms indicated that it was their policy to minimize layoffs as much as possible. "You may be interested to know that an informal follow-up survey we made recently showed that during the past year—which has not been a favorable period economically—74 percent of the survey firms have not had any layoffs."

However, a consensus-style management—which is considered "Japanese" by most analysts—is practiced by only a few operations in the United States. One of these is Kikkoman Foods Inc., whose system is described on pages 12 and 13.

About a quarter of all plants in the JETRO survey were unionized. Only a few reported instances of labor-management disputes. There was no difference between unionized and nonunion plants in quality of the product obtained from the work force. Mr. Tominaga said that companies entering the United States might consider the extent of union presence in choosing a plant location—but would also consider other factors, such as access to the market. He noted: "They try to adapt themselves to unionized workers."

Nissan Motor Manufacturing

"There is no greater priority in our new company than selecting and training a quality work force." Mr. Marvin T. Runyon, President and Chief Executive Officer, described these two operations in detail. Nissan has already hired 500 people for its truck manufacturing plant in Tennessee, choosing carefully from a pool of 40,000 applicants. By the time the plant begins production in August, 1983, its work force will consist of 2,100 Americans. By mid-1984, there will be 2,650 on two shifts.

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[1] Japan External Trade Organization (JETRO), *Japanese Manufacturing Operations in the United States: Results of the First Comprehensive Field Study*, September, 1981, (various pagings). Available from the Japan Trade Center, 1221 Avenue of the Americas, New York, N.Y. 10020.

Selection of plant workers, called "hourly technicians" by Nissan, begins with initial screening by Tennessee's Department of Employment Security. This yields applicants "who have the necessary skills to become maintenance, quality-control, material-handling, tool and die, or manufacturing technicians." Those who pass through this first screen have their first interview with Nissan, at which the firm's working style is discussed. If the applicant "passes," he or she is made familiar with Nissan in more detail. Applicants are then enrolled in the state's preemployment training, with no compensation. They are not yet Nissan employees, but the training is carried out in Nissan facilities.

> "We've recently opened a 30,000-square-foot training center at our site, which houses both a shop area and classrooms. We have demonstration models of all the robots, a paint booth, a maintenance area, and a variety of other demonstration equipment that provides our employees with hands-on practice."

Preselection training is followed by a third screening:

> "The best trainees are selected out of the preemployment training to move into the employee-selection phase, which is our final step before hiring. During employee selection, they undergo an in-depth technical skills evaluation and an assessment of their supervisory skills and abilities.
>
> "These people are then ready for a second and a third interview prior to hiring. The second interview is conducted by a panel from Nissan, including a manager and a plant human resources representative. A third interview—conducted by an operations manager, a plant manager, and a supervisor—goes into more depth with the potential employee."

A major emphasis throughout the training program is cross training. There are technological and psychological reasons for this, as well as industrial relations reasons. Mr. Runyon described cross training as "not traditional" in U.S. manufacturing. However, he said:

> "Because the new machine systems include complex interrelated subsystems that cannot be treated as independent skills, the workers must have a variety of skills to be able to work with the equipment. A robot, for instance, may have a servo system that incorporates electronics and hydraulics and, at the same time, is directed by a programmable controller.
>
> "Our manufacturing system will depend on workers who want to expand their jobs. They will be expected to participate in refining the manufacturing system and to make suggestions to increase productivity and quality. This requires an employee who is well-trained, shows initiative, and maintains a good working relationship with other employees."

Nissan is also investing in supervisory development. First-level supervisors are being taught leadership and team-building skills, and ways of enhancing the self-esteem of their employees. Teachers from local universities are involved in this program to teach new ways of relating to subordinates. Mr. Runyon observed that trying to run an entire business with this orientation (that is, greater self-direction and a sense of importance among production workers) requires a thoroughgoing conversion from conventional management practice.

> "First you have to teach the chief executive officer how to do it, then you have to teach every person down to the supervisor how to do it. They all have to be dedicated to the idea or it won't work. You can teach the supervisor, who can go out and do it and everything looks great. Then some problem develops all of a sudden. The general foreman or the superintendent or the manager to whom the supervisor reports just cannot accept that, because he has not been properly trained. A real training process, a real dedication to making the thing work, is necessary. It has to happen at all levels of management. You have to be careful and have 'people facilitators' from outside the organization who come in and say: 'You did it wrong; now go back and correct it.'"

Over and above the training being undertaken in the United States, Nissan is training U.S. workers in Japan. Some 425 Americans are going to Nissan facilities in Japan, among them 128 hourly workers. Supervisors and hourly technicians work on assembly lines there, learning process and equipment, and Japanese management techniques such as quality control (QC) circles. On their return, these people train U.S. employees.

Japanese personnel are coming to Tennessee, as well. Sixty-five technical employees are here to install and try out major equipment, and to help start operations.

> "For instance, we'll have an inventory control analyst who is familiar with the parts supply and shipping system. This person is scheduled to be with us from June of this year until December of 1983 to assist with the training process.
>
> "Beginning in February of 1983, we'll have a supervisor with experience in top coat from the paint shop for a period of about four months. He'll

> assist in robot training and in operating problems with paint robots."

One well-known Japanese technique—"just-in-time" delivery of parts for use in product assembly—is being introduced to Nissan's Tennessee plant suppliers.

> "When we start production, 62 percent of our parts will be coming from Japan; the rest will be procured in the United States. 'Just-in-time' parts delivery from Japan is going to be a little more difficult because of shipping. In our site-selection process, we found that we could cut eight to thirteen days from delivery time by bringing parts in through the West Coast, rather than the East Coast. That amounted to about $20 million of operating cost on current charges for inventory.
>
> "On the parts that we're buying locally, we are arranging with suppliers to set up a just-in-time delivery process. For example, Hoover Universal, Inc. will make seats in a new plant in Murfreesboro, nine miles from Smyrna. We'll be tied to them by a computer, and we will tell them what seats we want. They will be delivering on a one-to-two-hour basis.
>
> "We have contracted with the Ford Motor Company glass plant in Nashville, Tennessee (about 20 miles away). They will deliver the glass that we need about every three hours. Other people will rent, lease or build warehouses near our operations; we will draw parts from those warehouses. This is useful for other reasons than just cutting down inventory cost. Because if you push back the inventory to the suppliers, they are not going to be so anxious to have you loaded up. The first time one of those parts comes in and there is something wrong, you haven't got the defective supply—they have it."

Nissan will have "employee involvement groups" working on technical production problems. However, these groups will not be exact copies of Japanese quality circles. Mr. Runyon pointed out that quality circles took many years to develop in Japan, and that they were generated and operated by employees.

> "Supervisors are not members of those circles, at least in Nissan. Seven or eight hourly employees are in a circle. They get together and come up with what they want. One of the reasons that they work very well in Japan is that they are given all of the information they need to solve the problems they raise. They ask management questions like: 'How much does this piece cost?' 'And how much time does it take to do the job?' 'How much does a minute of labor cost?' They are immediately given that information.
>
> "That is a very strange thing to me. In my U.S. management experience, you would not give the information to a production worker who asked: 'What is my time on this job?' American management would respond: 'You have enough time to do the job.' 'And how much does the material cost?' Response: 'It's none of your business, you know, just put the part on.'
>
> "For quality circles to be effective, people have to know material costs; they have to know labor costs; they have to know tooling costs. Because, if they are working on something, they need to know what it is they need to work on. If the material cost is the big thing, then they work on material."

Mr. Runyon followed this comment with an example. While he was at Nissan in Japan, he saw a computerized, automatic warehouse storage "machine" and inquired about its cost and the savings from its use. The plant manager did not know—but the machine operator knew cost, payout time, and the number of people replaced. The operator knew more about the business aspects of the warehouse operation because it was a part of "his" job.

Nissan is designing tasks and jobs that are a good deal broader and more responsible than is common in U.S. manufacturing. The responsibility itself is seen as a motivator by Nissan management. Mr. Runyon described a typical U.S. auto plant job in terms of the irresponsibility that it fosters:

> "One of the reasons I am planning on low turnover is because the people who work in our operation are going to have more responsibility for their jobs. In the normal automotive assembly plant in the United States today, a production operator does a production job. That consists of putting on five bolts to hold a wheel in place. Then, about 20 operators down the line, there is an inspector. That inspector checks to see that those bolts are on, and that they are tight. If something happens to the socket on one of those bolts and it becomes damaged, the production operator notifies the supervisor that he has a broken socket. And the supervisor notifies the maintenance employee, who then comes down and fixes the broken socket. In the meantime, the line is stopped and the production operator is standing there waiting for the socket to be fixed. He may not have noticed it immediately when it broke. The inspector may not have been watching for those nuts because he has several other things to look at. Some defective product may have gone by.
>
> "Now our manufacturing technicians will have a responsibility to put the nuts on, and a responsibility to check them because they will not be

checked again in the plant. And, if that socket breaks, a responsibility to replace it.

"If people have responsibility to do their jobs, have something that is interesting to do, and have total control over it, I think they are much happier. In too much of industry today, we try to take all of the skill out of the job and just have a person do one simple thing. As a result, we have lost productivity in this country."

An example of the benefits of cross training (and the absence of work-rule restrictions) was graphically described:

> "In the area of the maintenance technician, for instance, in conventional U.S. plants today, if you had a malfunctioning welding transformer you would have to get a millwright to go up there on the rail where it is mounted and get it down to the floor. First, a pipefitter may have to go up and disconnect some pipes, so the millwright can bring it down. You might need a welder if the bracket broke. Four people: a welder, a millwright, an electrician, a pipefitter. Nissan will train its people in all of those skills so that one person can do that job."

There will be only five levels of management at Nissan USA:

- President
- Vice President (six, plus General Counsel and an Organization and Development Department, reporting to President)
- Plant Manager (three plant managers and a director of supply, reporting to Vice President of Manufacturing)
- Operations Managers (three to four operations managers reporting to a plant manager)
- Supervisors (three to eight supervisors reporting to an operations manager)

Supervisory ratios are affected by the level of technology. In the highly automated and robotized body-construction area, supervisors will direct about 11 technicians. In the paint operation, somewhat less automated, there will be 16 technicians reporting to each supervisor. In the trim and chassis area, the ratio will be about twenty-to-one because "there is less automation and more handwork."

Sanyo Manufacturing Corporation

Sanyo acquired an Arkansas television manufacturing plant in December, 1976 that had major management problems. Primarily because of a poor quality product, the company was close to bankruptcy. Its product had been bought by Sears, which asked Sanyo to buy the facility. Particularly because of concern about import restrictions on TV sets, Sanyo agreed to open a U.S. plant.

Mr. Tanemichi Sohma, Vice President, Administration for Sanyo Manufacturing Corporation, described the first meeting between the new Japanese management and its Arkansas work force. This was a first move to "grow" employee involvement and morale:

> "We inherited 500 people from Warwick, 350 union members, 150 salaried employees. This group was like a widow, and we are almost like a new husband, with Sears as the marriage broker. The love comes later. You know, the Japanese have been known for that kind of marriage for centuries, so we were not that afraid and we came in.
>
> "The first day, the President spoke in English for the first time in public. He addressed all 500 employees in the warehouse—a very simple speech but a very powerful one. He said: 'Let us work together in harmony and team work; let us make a quality product at a good price. Let everybody meet the customer and regain confidence from the customer. If we could do that, we are doing great. We can make money.'
>
> "So work started over coffee and donuts, and we had a little party. Sanyo brought transistor radios to each employee as an opening gift. And people loved it. They had never received that kind of warmth from management. So on the very first day they already began to like the new husband."

Before any other action, then, management gave priority attention to morale. The plant was "gloomy, dirty." Mr. Sohma said an effort to clean, "neaten up," and brighten the old plant began on the first day of operation. His description of the next morale-boosting moves suggests a particular understanding of employee relations.

> "The next thing is better communications with employees. We should not neglect any workers: As long as they are under our operation, they are Sanyo people. So let them know what we are going to do—what type of product is going to be produced; how we are going to move on to next stage, and so forth. We informed them precisely.
>
> "Soon, workers started thinking: 'They are not hiding anything.' The new husband is friendly. They smile, but there is still a big question mark in their minds. Many people came to me and asked: 'Are you going to give us a bonus at the end of the year? Or profit sharing?' I replied: 'This is a company we just started yesterday, and we cannot give you any promise. The former company promised you everything, but you did not get anything. So we would rather not promise.' We knew, deep in our minds, that we would definitely give them a bonus—but we didn't mention that."

In three month's time, Sanyo had added 300 people. Before Warwick had started to fail, the plant had a payroll of 2,000, which had shrunk to 500 when Sanyo bought the company. In adding to its work force in Spring, 1977, Sanyo sought out former workers and rehired them. At this point, also, the Japanese-designed television set was introduced. The employees were used to a reject (defective) rate of 10 percent—a rate "unheard of in Japan," Mr. Sohma noted.

> "Then, our reject rate became 3 percent, and next month 2 percent, and it is still coming down. Then the operators on the line started thinking: 'We are the same people, the same hands, the same minds making a good TV product.' Morale improved, of course, because we were producing a better product. Sears gave us more orders; money flowed in; a good cycle started.
>
> "People say 'the rich get richer'—and our place is just like that. The plant is getting noisier, busier; everybody starts smiling, and production becomes smooth. Toward the end of 1977, having started with 500 people, we had 1,500. And we moved up from making only 500 sets a day to 2,000 a day, then to 3,000. And all products passed inspection and went to the warehouse and then to Sears stores. So everybody was really happy. Although we had not promised, we paid a 7 percent annual wage bonus that year."

Personal involvement on the part of top management is apparently a major policy at Sanyo—as is the attention to detail suggested by this illustration:

> "I walk around the factory every day so that I get to know people and people get to know me. In the beginning, they thought that I was checking on them, that I thought the American work force may be slower than the Japanese. Actually, I was not checking on them. I was looking around to see that they were working comfortably. If I saw something wrong, then I responded immediately and sent the maintenance man to cure the problem. Finally, they realized why I was so inquisitive.
>
> "I often go out of town for business; sometimes I have to go to Japan. When I come back, I go to the factory immediately. People say: 'Where have you been? What did you do?' That reflects a very warm feeling and I enjoy it. Because people are now with me, and we are with them."

A similar policy theme is found in this description:

> "I open my office completely to anybody so that any question or any suggestion or complaint may be brought to me. I promised one thing—that I would listen to them. But I do not know how much I can take care of. Whatever the complaint, you listen and develop it the next day, or try to cure that situation *as soon as possible*. Then people notice that management is not sleeping. They are with us. You know bad news goes out in the factory in a few seconds. Good news goes slowly, but the idea penetrates day by day that the management is OK. That Osaka guys are not bad."

The plant that Sanyo acquired had been unionized by the International Union of Electrical Workers (IUE), though most of the employees were laid off by the time the takeover was accomplished. When it began to rebuild a work force, Sanyo sought out the former employees. It also sought out the union:

> "Our President always feels that Sanyo in Japan is a union company, and why should we be afraid of unionism? We should work with them and grow together. If we don't like what they are doing, we should be straightforward and tell them. And, if we want to change anything, there is no need for a surprise attack. So we should bring the people together beforehand, explain to them thoroughly, give them an understanding, and then we will have no problems. Sure enough, if we talk to them and give them enough time and preparation, they listen to us and notice how smoothly things run."

In other words, Sanyo deliberately included the existing union in its effort to create a spirit of cooperation. This involved making some changes in supervision—for Sanyo's reasons—that incidentally pleased the union as well:

> "Some of the general foremen are not really people-minded people, not really trying to improve the situation. Therefore, we removed those people to nonsupervisory assignments and brought in better people who could understand workers on the line. The union appreciated this effort."

Mr. Sohma mentioned a significant detail in the midst of discussing union relations that suggested volumes of standard labor relations text:

> "We brought in some Japanese workers, young, but with six to ten years of experience in making television sets. Their English was limited, but I told them: 'You don't need to teach them anything, just show them kindly. And if you have a problem, don't say a word. I will take care of it.' I said this because in Japan it is very easy to say the words: 'You're fired.' It is said as a joke, because Japanese are not fired for the rest of their lives. But in Arkansas, if that kind of language would have been used by mistake, Americans would think that, ah, these youngsters are bosses, they are firing us. So I

> told them not to use that language—language that causes fear. So there was no conflict between Japanese engineers and technicians and U.S. workers.
>
> "They did a fantastic job and they got respect. After Americans saw these Japanese youngsters working very hard, preparing for tomorrow so that the production would become easier and better, they followed and they started learning together."

About two-and-a-half years after the Sanyo takeover, the union contract came up for renegotiation. Management made a substantial offer that the union rejected—but made no specific demands itself. Then, the union struck. Mr. Sohma thinks that the strike began as a test of the new management's strength, and also out of recognition that the plant was now making money.

During the course of the strike, Sanyo management in Japan learned about U.S. labor relations practice: "This is a different country: Business is business. A strike is business, not feelings." U.S. management sat tight—neither trying to operate during a strike nor following Japan's advice, which Mr. Sohma characterized thus: "After all, unions are human beings and you've got to go and kneel down and then they will listen to you."

In the seventh week of the strike, the union asked for talks, "and the strike was over." During the question period, Mr. Sohma noted that 1982 is a negotiating year. He does not expect a strike. Sanyo has strengthened the personnel department to deal with the union. It also has "learned to do its homework" and to inform and negotiate "well in advance." Finally, the recession should dampen strike fire. Mr. Sohma described a very direct and open relationship with union officers over individual employee problems (or potential grievance cases):

> "We are a unionized factory so we call the union's board of directors and tell them there is an employee behavior problem that we don't like. Openly and from the heart, we tell them off. You cannot manage our company, then you have to listen to us because we are thinking of people and these bad ones have to be corrected. From that point, we talk for many, many hours. Then, finally, they will understand our Japanese way of thinking and start changing. This happens quite often.
>
> "But we have to be fair with them also. If they raise something that we are doing badly, then we immediately respond and change. Sometimes we have to pay the price of firing supervisors in order to accomplish a change. Because some of those salaried people are very strict and very hard on a worker. When that complaint comes, we watch carefully—if it is true, then we have to respect the union. But there is give and take. If we do something right, they have to do right also. That is the way we operate."

However, the anticipated negative reaction of the union has so far prevented Sanyo from introducing quality circles in its U.S. plant.

Japanese employees are said to identify with the company to the extent that they sing the company song, have company sports teams and company social engagements, even wear the company uniform. Mr. Sohma noted that company clothing would not be acceptable in the United States, or might be viewed as an imposition by management. On the other hand, Sanyo now has a company "olympics." There are many employee relations "tips" in his description of how they began:

> "The President of the corporation came after our strike and said: 'Sohma, there is something missing. Maybe the human relationship is still weak. Why don't you, like our entire company, do some sports event like a small olympics?' I got the union people together and told them this. Not forcing, but from the heart, we want to do it together. The union officers said: 'That's the best idea we ever heard. We want to do it.'
>
> "Next day I called all the salaried people and asked them. They said, 'No, it won't work in this country.' So I said: 'Salaried people are supposed to be with the corporation. That is why you are called white-collar workers. And what kind of attitude do you have? You better go back, cool your heads, and come back tomorrow morning.' Sure enough, next morning everything changed. They said: 'Let's do it, but we don't know how.' I offered to bring them the materials from Japan and show them how to do it. From there on we worked and set up all the different committees: food committee, game committee, ground committee, security committee, everything that we could think of. We did a beautiful organization job and had a fantastic olympics.
>
> "The President of the entire corporation in Japan felt so happy about this thing that he gathered all the executives and their friends to fly in to see that olympics. I was worried because American people never had experienced that kind of sports event. I didn't know if this would work, because on a beautiful autumn day American people love to go out fishing, hunting, and golfing. Why should they come to the factory with no pay and do something like that? I never prayed so hard in my life.
>
> "The next day was a beautiful day, and then the opening at 8:30. Many athletes were there—480, each team has 40 members, 12 different teams. They all wore different colored T-Shirts. And they

> were lining up. Then the people started coming—2,000 people. And this has become something of a tradition with Sanyo, Arkansas.
>
> "We worked for them: The captain of the team was a janitor and we were vice presidents working under him. And he told us what to do: 'You're running too slowly.' This thing not only really amazed the people, but the people liked it. Then they came to us and said: 'Let's do it again next year.' The second time we did a much better one—and 4,000 people showed up.
>
> "This is the way Sanyo wants to work with people. No matter how old our company is, our equipment is old compared with some new companies that are coming in from Japan with automation and robots and so forth. We don't have any. But we have a good human resource in Arkansas. So as long as we work with it, I think we can make the operation successful."

In Which Areas of Management Do Japanese Excel?

Professor Hirotaka Takeuchi of Harvard Business School described four areas in which Japanese excel. The first is in emphasizing quality as defined by the customer. Customer-defined quality, he pointed out, may differ from engineer-defined quality, and may include intangible elements such as the "services" delivered by the product. Japanese companies work with their suppliers to improve the quality of parts, often sending company staff to the supplier to "work together." Japanese companies also "transfer the 'ownership' of quality back to the workers." This phrase signifies placing responsibility for quality of output with the producer. Dr. Takeuchi noted that, in the United States, this responsibility is in the hands of an inspector (or an engineer), separated and divided from the producer. In Japan, "the attitude is: 'Let the workers own quality. Let *them* come up with the ideas.'"

The second area in which Japanese excel is in managing human resources. They use a maternal style:

> "What do I mean by a maternal management style? I am referring to a close, nurturing, caring type of relationship that you have built with your workers in which the objective is to develop them, enrich them, guide them, and motivate them. In short, it is day-to-day handholding that goes on between managers and workers.
>
> "First of all, training in Japan starts on the first day of employment. An example: In the cafeteria of an electronics plant in Tokyo, about 30 young girls, about 18 or 19 years old, came in with pencil and paper. I asked the manager I was with, what they were doing. He told me: 'This is their third day as employees. We have given them an assignment: Jot down one idea—one suggestion that you would make to improve the operation of the cafeteria.' These high school graduates are being socialized, conditioned and acculturated to think that the *status quo is not good enough*. There has to be a better way of doing things. In day three of their jobs.
>
> "They reward employees, not with cash but through peer recognition. If you walk into a Honda plant, one of the things that first strikes your eyes is a colored rectangular sheet of paper hanging over several employees on the assemblyline. If you make suggestions you earn certain points; if you earn 50 points, you get a red rectangular card—instant recognition. People know that you have done your job well. A pat on the back, positive reinforcement, goes a long way.
>
> "They let employees compete with each other in a constructive manner. Quality circles are a very competitive thing. What is the best QC idea of the year in a certain plant? They select the best idea through a contest. Then they compete at the regional level, at the divisional level, all the way to the national level.
>
> "The Deming Award is a national award to a company that has done the best job in terms of quality control. The whole thing is built on constructive competition, the day-to-day handholding, making sure that people in the organization are looked after. And the objective, to repeat, is to enrich, to develop, to motivate them."

Another aspect of maternal management is feeding employees extraordinary amounts of detailed information about company performance. This theme—the creation of an "insider" work force, fully knowledgeable about company operations—was echoed throughout the conference by each speaker.

The third area in which Japanese management excels, according to Professor Takeuchi, is in creating a corporate culture. He described corporate cultures by an example:

> "It is not the words of the CEO or the manager, but his actions, and those of other managers, that create the culture. The founder and chairman of Matsushita has a set of personal business philosophies that he has developed over the years. There are 21 as of today.
>
> "The first: 'The purpose of an enterprise is to contribute to society by supplying goods of high quality at low prices in ample quantity.' Number six of his business philosophies: 'The responsibility of a manufacturer cannot be relieved until its product is disposed of by the end user.'

> "Number ten: 'When you notice you have gone too far, you must have the courage to come back.' Number thirteen: 'The right assistance is to guide men in business to open their ways by their own hands.' This is the corporate philosophy held, published, distributed throughout Matsushita. No wonder we have the corporate man, the company man. The basic issue here is what do corporations really value? Can you pinpoint a value in your organization and say, 'This is what we stand for?'"

The fourth avenue to excellence is in marketing and competitive strategy.

> "They look at the globe as the marketplace, not the United States as one element. They have been doing two things simultaneously. They have been responsive to local needs, and, at the same time, they have been able to achieve standardization and centralization back home.
>
> "They have the most sophisticated and elaborate market intelligence system. Think of all the trading companies and the JETRO's scattered all over the world. These feed information back to headquarters to tell them what the local markets really want."

Professor Takeuchi emphasized that strategy and implementation, "thinking and doing," are all one in a Japanese company.

> "These companies have a bias toward action. In each of these companies, the key instructions are: 'Do it.' 'Fix it.' 'Try it.' The attitude of management is: Get some data and do it. Then adjust it—rather than wait for a perfect overall plan. The companies tend to be tinkerers rather than inventors, making small steps of progress rather than introducing sweeping new concepts."

Some American companies also have this characteristic.

> "They are customer driven, not technology driven, not product driven, and—most importantly—not strategy driven. They stick close to the customers, find out their needs, and then fill them.
>
> "They stress a key business value. The operating principle at well-managed companies is to do one thing well. Such single-minded focus on a value becomes a culture for the company. Moreover, well-managed companies stick to what they know best. They don't diversify into businesses that they are not comfortable with."

Professor Takeuchi's final piece of advice to U.S. managers:

> "It is about time we stopped thinking, and it is about time we started doing things. Management, to the Japanese and to successful U.S. companies, is a way of life."

Reorienting U.S. Managers

In opening manufacturing operations in the United States, Sharp had to be concerned with harmonizing Japanese and American "perceptions." Mr. Eddie R. Cox, Director of Television Manufacturing Division, with Mr. Masakatsu Tsuji, Vice President, Administration, Sharp Manufacturing Company of America, spoke of company philosophy as a major element in management. Initially, Japanese specialists were brought here to set up the production facilities and to train the work force. Almost every American in a supervisory and technical position had a Japanese counterpart. The interaction between these two individuals of different backgrounds was influenced, Mr. Cox said, by their preconceptions and receptivity.

> "We had to explore the work ethic. In general, the Japanese work ethic during the past few decades was 'Live to Work.' Their entire lives revolved around their occupations. This work ethic has one major disadvantage: The family life of the individual involved suffers. In contrast, the American work ethic recently has been 'Work to Live.'"

Another difference appeared in time frames: Americans live in the present and manage in a present-problem-solving fashion.

> "The basic American management approach has been to take care of the elephants and not worry about the gnats. The elephants are today's fires, or the big problems, which we must address and take care of and solve today.
>
> "However, Sharp's philosophy throughout 70 years has been and is to take care of the gnats. Every decision made by management is made with the long-term results in mind. Sometimes you sacrifice short-term results for the long-term results."

Indoctrination of Sharp employees begins with orientation of hourly employees and managers.

> "All new employees go through a very detailed training program on the Sharp philosophy, the creed, and a special address from the President of our company about his plan to make Sharp in Memphis the Utopia of work places in America and to operate this company on a family approach. This is how we try to train the managers to see that the hourly employees, who do the work for them every day, are members of their family."

Sharp also attempts to provide a level of job security (though not a job "guarantee") by using its work force differently from standard U.S. practice. Mr. Cox illustrated this management to produce continuity of employment—although not necessarily continuity of job function:

> "The manufacturing operations at Sharp cross product lines: one microwave oven line, one color television line. Fortunately, the economic pressures on both lines are not exactly the same at the same time. Therefore, we can transfer some workers between the TV division and microwave oven division.
>
> "It is management's responsibility to fulfill the hiring commitment: When we hired the employee, we had a job for that person. We have had them repainting areas of the building. We have had certain employees go into special training, such as an all-day training session on the consumer electronics market for the past 20 years in the United States. By the way, this gave employees information that was totally unheard of for hourly employees in the past. We try to teach them what the industry is like. We even had a course in cardio-pulmonary resuscitation when we did not have enough work in the production schedule to occupy them.
>
> "We have not laid off any workers. It is management's responsibility to take care of the employee for the long run—and the employee will repay the company with loyalty in the long run."

Sharp has brought the Japanese practice of working with suppliers to its U.S. operations.

> "Between 80 and 90 percent of our total cost is in materials, much of it from American suppliers. Sharp sends engineers, technicians, quality-control people to our vendors' plants to work with them on improving their quality. When we started talking about higher quality, the first response that we heard was 'higher prices, higher prices.' But we have been very successful in showing our suppliers that higher quality can *reduce* costs. If they have a process control that does not build defects, then their internal costs are lower. They have responded to us very favorably in this and other ways."

Motivating Employees by Means of Peer Pressure

Martin E. Fanning, Vice President, Industrial Relations at the Japanese-owned Auburn Steel Co., Inc., near Syracuse, New York, emphasized company education of employees, as did the other speakers at the conference. In particular, he described a very broad kind of education and company indoctrination as providing the setting in which employees encourage, monitor and stimulate each other to higher levels of performance:

> "The process of training U.S. workers to run things Japanese-style has been in effect since the first day Auburn Steel began operations. The atmosphere is very, very informal, with all employees calling all other employees, even members of top management, by their first names. There are no time clocks.
>
> "All employees are salaried within three payroll groups. Management is paid on a monthly basis; administrative, clerical and first-line supervisory personnel are paid semimonthly; production and maintenance employees (classified 'nonexempt salary') are paid weekly. This last group receives premium pay for overtime on a weekly basis, not on an eight-hour shift.
>
> "All employees work as teams whose members are trained to perform *all* the jobs that the team is responsible for. Thus, the company has maximum flexibility in assigning workers."

One of the most important aspects of job flexibility is the responsibility it permits workers to assume.

> "We only have five pay classifications at Auburn Steel, compared with twenty-eight or thirty in a typical mini-mill. In such classic mills individuals work within a graded hierarchy of jobs, each with definite responsibility and varying pay rates. Auburn Steel intentionally has no job descriptions, thus deemphasizing salary groups and avoiding the 'that's-not-my-job' syndrome. From the employee point of view, it gives each an opportunity to learn and perform all the jobs performed by each team, thus creating a job enlargement and enrichment situation available to the degree desired by each individual employee. From the company point of view, it provides a greater number of cross-trained employees and provides greater flexibility and capability. And to everyone's advantage, it creates a reservoir of promotable talent."

The work team, not the individual, is central to operations at Auburn Steel.

> "The teams are small work groups, with the supervisor clearly identified as the leader responsible for the workers' welfare and for the resolution of their problems.
>
> "Daily personal contact at work is supplemented by informal meetings off plant site, which supervisors often sponsor voluntarily. Workers are continually made to feel appreciated as an integral part of the company. At weekly meetings with foremen, the first question asked by a superintendent typically concerns employee morale.
>
> "Individuals become part of a team right from the beginning, since the company normally hires in groups of 10 to 15. A sense of cameraderie develops

during that first week of tours, safety lectures, job demonstrations, movies, reviews of emergency procedures, and instruction in operating practices. The group receives a complete explanation of company policy and organizational principles, as well as of company benefits. Their responsibilities as Auburn Steel employees are defined, as is the team concept.

"During the first week, new employees meet with every single company official, each one explaining his or her role at Auburn Steel. The President comes in, tells what he does, or what he tries to do. So our vice presidents—marketing, finance, and so on. We give the employees a complete run down on the company: Where it came from, how it got there, what we have done to date, what our plans are. Employees are paid for this orientation."

Performance measurement is also based on team work:

> "It is very easy to measure the productivity of a team. For example, in the melt shop we operate 24 hours a day. On any given day, three teams would be working, one from 7 am to 3 pm, one from 3 pm to 11 pm, the other from 11 pm to 7 am, a fourth team would be on its day off. At the end of an eight-hour period, we have the data on how many tons were produced and what was good and what was bad.
>
> "When a team achieves a record, there's a reward; and there is a fair amount of competition. A lot of the rewards are going out to dinner. When a team achieves a production record, we take the whole team out and have an open bar and a dinner. Some may say: 'Well, that's a pretty steep price to pay.' But when you look at the production records and what they have achieved, it is really insignificant.
>
> "The first element of reward is personal pride. Then, there's the esteem of the other teams. And the team that set the record knows full well that the others are coming up right behind it. We feel it is genuine; we have tried not to make it manipulative. The thrust is the better a team does, the better the department does, the better the company does."

Apart from rewards, the teams get together in various social ways that have a work element in them.

> "There are team meetings, sponsored by the supervisor, at the local restaurant or a pizza place where they'll go and have a pizza and a couple of beers, sit in the back room, and talk over problems. These are voluntary, but attendance is high. About 60 percent of supervisors do this; 40 percent do not because they accomplish their communication in other ways. Some have meetings at their homes. Some teams have quarterly parties at somebody's home. They are involved, and they just can't help talking about work."

Absenteeism is also controlled by team pressure. Salaried production workers are usually paid during an absence (that is, supervisors usually authorize salary payment at the normal level). One might expect that workers might be absent more frequently without the disincentive of losing pay. This is not the case: Absenteeism runs at 1 percent, less than half the national average. Mr. Fanning explained: "Team members automatically fill in for anyone who is absent, and they usually do this without a replacement." Under these circumstances, the team affects an individual's sense of responsibility about regular attendance.

Consensus Decision Making at Kikkoman Foods Inc.

Kikkoman's management of its plant in Wisconsin is "American in form, but Japanese in style." When the plant opened in 1973, management in Japan decided to use two U.S. customs: pay for the job function (rather than on a seniority or other status basis); no lifetime employment guarantees (that apply to men in Japan). However, since the Japanese managers who came here had no American training; "they have managed just as they did in Japan, even within the U.S. form."

Dr. Danji Fukushima, Executive Vice President and General Manager, suggested that there are two areas of difference between U.S. and Japanese practice: (1) the process of decision making, and (2) the company's relationship with its employees.

Decision making, Japanese style, starts at a lower level, and is more accurately described as the development of consensus among employees. Dr. Fukushima explained:

> "We obtain a much greater degree of consensus among all levels of personnel. Usually informal discussions or meetings are held before the formal meeting. If an impasse is reached at the informal meeting, the decision is delayed. Further research work and discussion on an informal basis continue, and the issue is discussed again and again until there is agreement. In the decision making at the lower level of management, all the workers who are involved in the issue participate in the discussion.
>
> "Generally speaking, this style of decision making takes a longer time. However, once the decision is made through this process, everyone is willing to implement and accept the decision because they all had a part in it.
>
> "The Japanese production managers are not hesitant to take a different position than top management on an issue. They have no fear of job insecurity, demotion or loss of promotion. Nor are

> they fearful that someone else, even a subordinate, might have a better idea. Japanese industrial personnel have been discussing matters from a wide point of view for a long time, and top management never rewards the managers who propose and adhere only to their own opinions. This important aspect has been brought to the Kikkoman U.S. operation by the Japanese managers, and it has emerged as an important element in our operation."

There is also an on-the-plant-floor consultation that is continuous. Mr. Thomas Godfrey, a director of Kikkoman Foods Inc., described this ongoing discussion:

> "At some point in every worker's day, he and his immediate supervisor discuss a problem of manufacturing and a problem either of making the product better or of making it with less work or effort. In other words, we do not gather them together for ten minutes a day, or for an hour a day, and say: 'We're going to discuss.' Our level of supervision and management is such that workers understand and know that they have the right to come to the particular person and make a suggestion—and that suggestion is not ignored. It is a continuous process, and, believe me, it is present in the plant."

The company's relationship with employees was Dr. Fukushima's second point of differentiation between U.S. and Japanese practices.

> "At Kikkoman, unlike many American companies, the primary concern is always the employee. Employee interest will never be sacrificed for quick profits or other short-term objectives. This respect and consideration for each individual can be found in our daily work practices. For example, if there is a business slowdown and production must be curtailed, hours of all individuals, top to bottom, are reduced rather than laying anyone off. Thus, we practice a Japanese management style within the American form of management with very good results.
>
> "For instance, our United States plant productivity is no less than that of Kikkoman Japan. The product here is competitive in quality with the products produced in other Kikkoman plants in Japan. Absenteeism and turnover rates in our U.S. plant are below industry averages in the United States. According to the Bureau of National Affairs, Incorporated, absentee rates in U.S. manufacturing in 1980 averaged about 2.6 percent monthly; Kikkoman's rate was 0.3 percent. Turnover rates in 1980 for manufacturing in the United States averaged about 1.4 per 100 workers a month; Kikkoman's turnover rate was 0.1 percent.
>
> Mr. Godfrey added: "Considerable efforts are continually made to develop company loyalty. The company not only provides a place for its employees to work, but it provides a core or center for the employees families' social activities. These are all planned and managed by the employees with the support of the company, and management participates in all of these social events. This adds to a cooperative spirit within the company.
>
> "Company pride is also a factor. We do have a company song, which is sung at various occasions, as is typical of a Japanese company. And we had it at the time of our grand opening. This single act in itself may not be significant, but it adds up in the total picture. A company flag is always proudly displayed. An annual event sponsored by the company is the Anniversary and Awards Dinner. Upon obtaining five years of service, all employees, including management, are presented with a gold ring with a diamond. For each additional five years of service, another diamond is added. This gift is awarded for the employee's loyalty and service to the company. This next year, in 1983, we will be awarding our second diamond to eight employees, who are eight of nine we hired in 1973, and we are very proud of the fact that they are still with us. The event is always greeted with a great deal of anticipation and enjoyment."

Creating an Environment for High Technology Employee Participation

NEC Electronics U.S.A. Inc., a semiconductor company owned by Nippon Electric Company of Japan, has a hybrid management system. Mr. Charles L. Wood, Executive Vice President and General Manager, Electronics Arrays Division, explained:

> "We are bringing two industrialized countries together and two technologically advanced companies together. It is one thing to go to Southeast Asia and to put a management system in when you are dealing with a clearly inferior industrial situation. But Japan and the United States are essentially equal as far as industrialization, and the technology is essentially equal for semiconductors. So, we had to approach this very carefully in order not to have a backlash on either side—Japan or the United States."

Most important is the "creation of a culture of trust":

> "I believe that management is responsible for creating and supporting a company environment leading to trust. It is management's responsibility to

> establish that environment, and it has to start at the top. You just can't do it if you do not get the support at the top. From our experience, it is necessary to have the cooperation of the CEO, the general manager of your operation, the head of the department that you are trying to influence if you're heading a function within your organization.
>
> "This is because the issues usually are complex enough on their own without creating a question of trust. Most problems are very complex today. And you can't go in saying: 'Do I trust you? Am I getting all the data? Am I going to share all the data with you?' It makes it very difficult to be able to work on an issue without having trust."

In order to further organizational trust, NEC Electronics uses a (General Electric-developed) two-tier performance review, in which an employee's supervisor does the review, and then his superior is "equally responsible for that person's review if there is a problem."

Mr. Wood explained that, instead of projecting an opinion or conclusion, management shared enormous amounts of data. It also communicated fully, in terms of "the real message." This involved a great deal of one-on-one discussion. "Two people talking about an issue or a problem: This is one way we develop trust."

> "Management is responsible for creating an environment that facilitates horizontal and vertical communications in both directions. Management is responsible for creating an environment, period. I'm not saying, 'do it.' I'm saying: 'Create the environment that allows it to happen, by both vertical and horizontal communication.'
>
> "If you look at things in their simplest form, most problems and issues revolve around communications. There may be legitimate differences of opinion about data, and ways to solve the problem, but that really comes down to communications. It is inexcusable for that to be a reason why you can't solve a problem. Therefore, we pay a lot of attention to our communications environment at NEC, not only to Tokyo, but to functions within a division."

Mr. Wood's affirmation of information sharing as a principle was particularly pointed:

> "Many managements hide behind confidentiality. I'm not talking about whether you are unionized, or whether you are a government contractor, or whatever. A lot more data can be shared a lot more openly if management wants to do it. We Americans just don't want to do it. Fundamentally, we don't share the data nearly as openly as we could.
>
> "Data have to be shared openly in order for people to understand what the issue is, what the facts say. NEC does not hide behind the confidentiality curtain because you can't get trust if you hide behind confidentiality. Your supervisors have to get used to being able to post results or what is happening and quit going around with it on the back of their cuffs because they don't want anybody else to know. Supervisors have to get over their paranoia and get those data up so everybody can see them."

Visiting another Silicon Valley electronics company, Mr. Wood gained some insights and ideas. He found that "they have a beer party once a month out in the parking lot, to talk about how they did that month." But if the month's results are poor, there is no party because there is nothing good to talk about.

> "People come in at 6 o'clock in the morning so they can leave two hours earlier in the afternoon and still get the production out.
>
> "That's not a bad idea. They were having their all-employee meeting, and I found out that they have an all-employee meeting every month."

At NEC's annual all-employee meeting, Mr. Wood felt that he was being subjected to "turkey shoot" criticism. He

> "found out that a lot of the things I was trying to share with everybody were not getting to the people. It turned out that what we had is a large number of people who do not share as openly as you may want them to. They think: 'Well, they don't need to know that.' Superiors make all these nice decisions for you.
>
> "I didn't like that. So, I went to my staff and said, 'We're going to have an all-employee meeting every month. And, by the way, I'm not going to be giving that employee meeting every month. You are going to have to share in that, and about every third month I'll give it.' 'Oh, wait a minute. I don't think we should do that. It's a lot of work to prepare for it.' I had to convince my own staff about this. I didn't have any problems with the employees.
>
> "We have been doing this now for about 15 months, and the turkey shoot is over. The first few times we had these, they just came out and dumped all over me. Now, we're getting down to some substance. It allows the people to know what the corporation is doing. And that is really what we want to do. What is the corporation doing? What objectives are we meeting? What objectives are we failing to meet? And are we stretching too much for an objective, or are we setting unrealistic objectives? Is the product quality what it should be?"

Another example of communication is the company's focus on data:

> "We use charts and graphs. My objective would be

> to chart and graph every single variable in the corporation and post it where people could see it, so they can know what the objective is and how we are doing against the objective. I cannot overstress the importance of charts and graphs. Employees love them. Again, there are problems with getting middle-management people to do it: 'Well, that's confidential. They should not know this. Well, we missed that objective.' If you missed it, post it. If you make it, post it. And don't set objectives that are unattainable, because you want to set up a win-win condition, not a win-lose one."

Mr. Wood was President of Electronics Arrays, Inc., when Nippon Electric Company of Japan bought it. He explained the three goals of that merger:

> "We were a low-volume, job shop operation: We wanted to shift it to a high-volume production facility. Also, we wanted to transfer automated-assembly technology from Japan to the United States. Thirdly, we wanted to introduce new quality-control techniques—the quality-control techniques that worked in Japan that we felt would work in the United States.
>
> "I think there is a success trap that people get into when they fail to realize that steady and constant improvement is required. In this particular situation, we did not look for huge changes. We wanted small, but constant, changes. We had to marry the Japanese technology to the U.S. technology. We had to create an internal attitude to do that. And we had to improve yield. This requires constantly changing the environment, changing the product design, changing the equipment.
>
> "We have been able to increase our annual sales per employee from $20,000 in 1978 to over $100,000 today. I am quite certain that a large portion of that increase has been due to some of the things we have tried to introduce at Electronic Arrays since the merger with NEC."

With regard to two other hallmarks of Japanese management, in California NEC does not have employment guarantees, though it is less quick to lay off than other electronics firms. It is just beginning to set up quality circles because of a concern that the advice and conclusions (or study results) of a quality circle must be accepted and acted upon by management to sustain management credibility. Until he could be sure of this acceptance and action, Mr. Wood did not want to risk setting up a QC. Finally, Mr. Wood returned to the information-sharing theme:

> "This confidentiality excuse is one I've been fighting in every corporation I've ever worked for, for the last 20 years. Everybody hides behind it; every corporation I've ever been affiliated with hides behind it. We refuse to tackle it; we shy away because it is not in our culture to fight it. But we have to fight it because it is so keyed to creating trust."

Summary

Academic literature has identified, in general terms, major distinguishing elements of Japanese management style. At the conference, speakers described specific measures and recounted incidents that might be matched with the abstractions of theoreticians. The speakers are, however, practitioners—managers--so their descriptions are more operational and "practical." Moreover, they conveyed a feeling of delight and conviction: "You must try these ideas yourself: they really are effective."

They also made it clear that Japanese management is not a "system" that can be established and "installed." Each described some shift of operating concept and framework within the manager; each emphasized "the little things," the minutiae of working relationships that comprise the recipe of Japanese style. Therefore, a summation of these discussions is, perforce, impressionistic.

The pervasive theme was *information-sharing* among all employees. This element is ever-present in the discussion summaries. It is fundamental to the involvement of the work force in a Sanyo, an Auburn Steel, a Sharp. It is a precondition for consensus decision making at Kikkoman, and to the holistic development at NEC Electronics. It is a planned deviation from standard U.S. practice at Nissan.

Another theme present in nearly every discussion was the *presence of management among the work force*—on the shop floor, in meetings and discussions, at informal social events. In fact, there seems to be a busy, "talky" interrelationship going on among all individuals. Segmentation of work groups, hierarchies and fiefdoms are not mentioned because they cannot grow in such an environment of "management by walking around." The abstract term for this might be "communication," but the speakers clearly understood their actions as practical, commonsense measures—not as "concepts" or "systems."

The meeting took place at an opportune time for learning: U.S. firms are curious about the remarkable results achieved by Japanese firms operating *here*. In addition, the decades-old neglect of operating management seems to be giving way to a new appreciation of the shop floor. U.S. companies seem to be rediscovering the production level, product quality, output costs as one of the major elements in company competitiveness. This recognition puts U.S. management in a mood to learn from the world's innovators in production management—the Japanese.

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Japanese Investment in the United States:

An Opinion Survey of Elected Officials

by
Audrey Freedman
and
David Bauer

The Conference Board

SOURCE OF DATA

The Conference Board surveyed 256 governors, senators and representatives whose state or district contains one or more Japanese-owned manufacturing companies. The list of Japanese-owned companies came from the Japan External Trade Organization. Responses received from 64 elected government officials between October, 1982, and March, 1983, provided the data for this report. Thirty-three of the respondents were governors; fifteen were senators; and sixteen were representatives. There were 34 states represented in this survey.

The Conference Board asked the elected officials the following questions:

1. "Do you think a Japanese business presence is beneficial to the economy of your state?
2. "What are the benefits or drawbacks?
3. "Would you like to see more capital investment by Japan in your state—and if so, in which industries or sectors in particular?
4. "Do you think direct investment from Japan helps reduce trade conflict?

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JAPANESE INVESTMENT in the United States is welcomed, in nearly unqualified terms, by elected state and federal officials. Many states actively seek foreign investment, viewing the capital inflow as a stimulus to technological advance and employment of the local labor force. To the extent that the Japanese facilities involve high technology, however, they are less likely to be labor intensive—particularly of production workers. The elected officials suggested that foreign investment in U.S. production facilities tends to reduce trade conflict, though some responses called for reciprocal openness from Japan on both imports and capital investment.

The Benefits of Japanese Investment

Employment is the main beneficial effect of incoming Japanese capital, according to elected officials (see Table 1). In some cases, "jobs" were cited as the only benefit. Some answers described job creation rippling through the local economy and including domestic employers as well:

> "First, new investment increases job opportunities for Pennsylvania. Second, new investment encourages the establishment and/or growth of complementary businesses which will also increase job opportunities. For example, a manufacturing plant might require certain raw materials, which could be provided by nearby suppliers. Additionally, service industries (supermarkets, banks, etc.) would evolve to provide services for those employed by the firm."

Two respondents noted somewhat ruefully that Japanese investment in heavy industries (such as steel) had "retained" jobs in a shrinking industry. State governors cited a benefit that they mentioned in conjunction with employment, namely, additions to the local tax base. For example:

> "The increased investment adds to the capital stock, which provides the basis for maintaining or accelerating economic growth. This results in the creation of additional tax revenues, jobs and income for residents and helps the state's balance of trade by increasing exports from California to the world's economy."

Stimulation of exports, either from the state or from the United States, was mentioned by nine respondents. In some cases, such exports might be raw materials—such as coal, lumber and agricultural products—exported for processing elsewhere. In other cases, Japanese capital may generate U.S.-based transformation of our raw materials into finished products for domestic and export markets. Such an investment in U.S. processing and manufacturing would be warranted by the cost savings (especially in transportation) of using natural resources on site, or within the country of origin.

However, a broad resource base alone will not "create" manufacturing jobs. It is necessary that U.S. processing and fabrication using those resources be sufficiently cost-efficient to retain the comparative advantage through the stages of manufacturing. If "made in the U.S.A." means poorly made or expensively made, then Japanese (and others, including Americans) will invest in manufacturing facilities located elsewhere.

For this reason, three of the benefits cited are critical to further job growth: (1) the introduction of better production-management techniques, (2) introduction of new technology, and (3) training the U.S. work force. Management innovation was described as "new ideas and new approaches to business and development" and "new methods of production." One West Coast congressman commented: "The long-haul attitude of Japanese firms is something U.S. companies should have. Our managers

Table 1: Beneficial Results of Japanese Investment

Specified Benefit	*Frequency of Mention*
Employment	62
Capital inflow	19
Introduce new business or production management techniques	15
Add to local tax base, revenues	13
Technology transfer to the United States	11
Add to mutual understanding, add diversity of culture	11
Stimulates local (or U.S.) export	9
Provides healthy competition	7
Procurement in United States, stimulates complementary enterprises	5
Decreases U.S. imports	5
Attracts other (Japanese) firms to locality	5
Diversifies industrial mix	4
Trains U.S. work force	3

need educating." There were some specific reference to employee development, such as:

> "Japanese investment, in particular, offers the potential of introducing new management styles to American workers. This could, potentially, increase productivity."

The new management style includes investment in the U.S. human-resource base with which the Japanese managers work:[1]

> "Besides the obvious economic benefits that accrue to a community that attracts a new industrial facility, the Japanese have a strong concern for employee skill development and growth, and effective labor-management relations,"

according to one respondent.

By acquiring new technology, the United States can retain manufacturing that otherwise would migrate to countries with lower costs. With Japanese capital come Japanese engineers and managers—carrying their know-how, according to eleven respondents. More generally, when industries in which more Japanese investment is desired were listed (see Table 3, page 7), a potential technological contribution seems to have been the paramount attraction. Americans hope, as one respondent put it, that "exposure to Japanese production systems and management techniques may lead to improved productivity."

Japanese may have some reservations about sharing, and thus giving up, some of their technological advantage. In an article urging Japanese industry to do just this, technology expert Masanori Moritani of the Nomura Research Institute suggested that it would be difficult:

> "No other nation can equal Japan in enthusiasm for the absorption, accumulation, and improvement of foreign technology. It is highly unlikely that any other country would be able to upgrade imported technology to the point where it would surpass that of the donor country. The West has never shown any great aptitude for improving and upgrading."

Moreover, he added:

> "Japan has a tradition of giving more weight to production than to development, resulting in great attention being paid to the production end of industry. No such trend is seen in either the West or the newly industrializing states. Thus even if other countries initiate production on a development and design level equivalent to Japan's, there is no reason to suppose that the products produced will ever catch up with their Japanese counterparts in terms of quality and reliability."[2]

Drawbacks

Very few drawbacks to Japanese investment were cited. Four respondents were concerned that the newcomers might outcompete U.S.-owned firms. One said:

> "The obvious drawback would involve a Japanese plant investment in Wisconsin which is so much more competitive than similar existing firms in the state, for whatever reason, that the 'Wisconsin natives' would lose a large share of their domestic market to the Japanese firm. The result would be a net loss to the state of employment and healthy firms."

Competition was seen as a *drawback* by four respondents and a *benefit* by seven. The ones who saw beneficial effects thought that the introduction of more competition would invigorate American firms, not overwhelm them. One said, for example:

> "New products introduced by Japanese companies stimulate the competitive acumen of our indigenous industries."

Another said Japanese investment

> "expands the competition not at the expense of, but rather with the cooperation of, American workers."

One response expressed concern that a Japanese business presence in defense industries might not be in the national interest. In the area of defense-related research and development, such as electronics, it might be imprudent to allow U.S. firms to be replaced or weakened by foreign-owned companies. Some other drawbacks cited (once each) were: gives Japanese access to U.S. technology; creates reliance on foreign enterprise; establishes foreign ownership of "our" agricultural real estate; creates a potential for "political control" and pressure; draws profits out of the United States. Two respondents generally observed that Japan has not welcomed U.S. exports or U.S. capital reciprocally.

Why are Japanese Companies Here in the First Place?

Spending by foreign firms to build, expand or acquire manufacturing facilities in the United States is growing more rapidly than either the domestic or foreign investment outlays of U.S. companies. The cumulative value of investments in the United States by foreign manufacturing companies currently exceeds $30 billion. The latest official data available, however, are for 1981 (see Table 2). The rate of growth has slackened since 1980 because of recession in this country and abroad. While foreign investment during the remainder of the decade may not maintain its previous growth rate, the foreign presence will continue to expand appreciably.

Investments in the United States by Japanese companies have accelerated faster than those of any other major industrial country. Investments in "brick and mortar" by the Japanese were virtually nonexistent prior to 1970. Therefore, despite the rapid increase, the current value of Japanese *manufacturing* investments—estimated at $1.3 to $1.5 billion—is relatively small. To date, the trading companies of Japan have been that country's major overseas investor, and their U.S. holdings of $4 billion are exceeded only by those of the British. Conference Board data indicate that the recession has not slowed Japanese investment to the same extent as investment from other countries. The rapid growth of Japanese investment vis-a-vis that of other countries is expected to continue throughout the 1980's.

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[1] The Conference Board reported on this investment in Audrey Freedman's, *"Japanese Management of U.S. Work Forces"* Research Bulletin No. 119, 1982.

[2] Masanori Moritani, "A Technological Strategy for Import Expansion," *Economic Eye*, published by Keizai Koho Center, Tokyo, June, 1982, p. 28.

This growth will continue despite the frequent reluctance of Japan to invest in the United States and the often defensive nature of these investments (see box). Until the late 1960's, investment was limited by the Japanese government because of balance-of-payments considerations, and by Japanese firms because of their emphasis on serving the domestic rather than the foreign market. By 1971, however, the Japanese government was encouraging foreign investment as a means of reducing what the 1976 benchmark study of the Commerce Department on foreign firms called an "embarrassing large" official foreign-exchange reserve.[1] At the same time, Japanese firms began to locate manufacturing facilities outside the country, although their motives for doing so were distinctly different from those of most other firms entering the U.S. market.

In general, the early investments were supportive of Japanese exports. These investments were made to establish U.S. marketing and service networks; frequently with the acquisition of a U.S. distributor. Later investments were made to establish manufacturing facilities, but in the words of the Commerce Department study, this was done "with some reluctance as a defense measure of the last resort." Most Japanese companies would have preferred to continue the policy that had been so successful in the 1950's and 1960's, that is, produce in Japan and export to foreign markets.

A JAPANESE POINT OF VIEW: REASONS FOR INVESTING IN THE UNITED STATES

"Reasons for advancing overseas could be broken down into five categories: (1) investment for the purpose of getting around import restrictions (tariff barriers or import quotas) adopted by foreign governments by replacing exports with products manufactured locally; (2) direct investment for the purpose of opening up new markets; (3) switches to overseas production occasioned by Japan's loss of comparative advantage in competitiveness following increases in domestic wages or material costs; (4) investment for the purpose of promoting triangular trade through exports to third-country markets; and (5) investments made as part of technical cooperation projects."[1]

[1] Kazutoshi Koshiro, "How Overseas Investment Affects Employment at Home," *Economic Eye*, published by Keizai Koho Center, Tokyo, June, 1982, p. 34.

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[1] *Foreign Direct Investment in the United States*, U.S. Department of Commerce, April, 1976.

Table 2: Foreign Direct Investment Position, Selected Countries, in the United States at Year-end 1981
(millions of dollars)

	All Countries	*Canada*	*Germany*	*United Kingdom*	*Switzerland*	*Japan*
All industries	$89,759	$12,212	$7,067	$15,527	$4,368	$6,887
Manufacturing total	29,533	5,787	2,917	5,910	2,731	1,111
Food products	4,791	2,380	25	528	550	57
Chemicals	8,488	162	1,855	1,634	1,243	266
Metals	4,325	1,172	170	962	338	262
Machinery	4,626	1,044	605	585	230	319
Other	7,303	1,030	263	2,202	369	207
Trade	17,734	1,285	2,271	4,362	607	4,128
Finance	7,448	398	301	2,250	225	1,093
Insurance	5,896	402	764	2,360	641	217
Real Estate	4,564	912	183	436	-1	131
Petroleum	17,813	1,547	56	-212	29	7
Other	6,770	1,880	574	420	135	201

Source: U.S. Dept. of Commerce *Survey of Current Business*, August, 1982, Table 10.

By the beginning of the 1970's, a number of factors combined to threaten Japan's growth in these markets, notably the U.S. market. The devaluation of the dollar in 1971 and 1973 raised prices of imported goods to Americans, and lowered the cost of building or buying U.S. production facilities. U.S. protectionism grew. The merchandise trade deficit of 1971 was the first experienced by this country in over 80 years. Subsequent and larger deficits gave rise to increased tariffs and quotas on items such as ball bearings, textiles, motor vehicles, and various steel products. The imposition of tariffs and quotas, coupled with periodic "voluntary" agreements by the Japanese to limit exports of television sets and automobiles, and frequent charges of dumping had ramifications far beyond the individual products involved. Japanese exporters of any product that achieved large market shares in this country had to consider the possibility that U.S. restrictions would limit sales, a consideration that led many firms to establish U.S. production facilities.

Conditions at home also made overseas expansion attractive. Japan's virtually complete dependence on imported oil made a U.S. location more attractive to large energy consumers. Producers of chemical fertilizer products, metal fabricators, and pulp and paper producers sought U.S. sites as pollution controls and a scarcity of land in Japan curbed expansion of facilities; growing scarcities of workers also throttled domestic expansion plans of many firms.

Location

Roughly 300 Japanese firms had manufacturing plants in the United States at the end of 1981. The vast majority of these firms owned 50 percent or more of their 428 U.S. subsidiaries. The Japan Economic Institute, which monitors the activity of Japanese firms on a regular basis, lists 105 of these subsidiaries in California, notably in the Los Angeles area. Data compiled by both The Conference Board and the Institute show that Japanese companies do not exhibit the marked preference for Sunbelt locations commonly ascribed to them. While Georgia and Tennessee have attracted a large number of firms, so also have the "smokestack" states of New Jersey, Michigan, Illinois, New York, Pennsylvania and Ohio (see box).

The success of traditional manufacturing states in attracting Japanese (and other foreign) companies rests upon several factors, one of which is the availability of labor. Japanese producers of industrial products and supplies such as bearings, machine tools, power equipment, medical equipment, control cables, and other goods have chosen these states in no small part because of their supplies of experienced industrial workers.

STATE OUTREACH PROGRAMS

State offices of economic development endeavor to attract capital in the United States, and increasingly from foreign sources as well. At least 17 states have offices in Japan (usually in Tokyo) to promote trade and to market the state as a site for U.S. operations. In addition, some U.S. cities and regions maintain Japanese offices.

Michigan's office in Tokyo was opened ten years ago, but this move was more recent for most states. For example, Pennsylvania responded:

"We have established foreign trade and investment offices in Western Europe, Tokyo and Mexico City. Since the offices were established a little over a year ago, foreign manufacturing operations were attracted to Pennsylvania as a direct result of the efforts of these trade representatives. Currently, there are over 430 foreign-owned firms located in Pennsylvania that provide over 95,000 jobs for Pennsylvanians. In addition, our state has expanded its industrial advertising campaign to include ads in foreign business journals. According to The Conference Board, Pennsylvania ranked fourth among the states in attracting foreign investments between 1979 and 1981. Pennsylvania is proud of these accomplishments and will continue efforts to inform foreign business that Pennsylvania is a good place to do business."

The Governor of North Carolina said:

"We have a North Carolina office in Japan. In North Carolina we have an industrial developer who speaks fluent Japanese. He devotes full time to recruiting for Japan. Japanese investments in our state represent their latest technology."

Maryland's program to attract Japanese investment extends beyond its office in Tokyo:

"To lay the foundation of good will and to establish closer ties with the international business community, Maryland has recently established sister-state relationships with Japan's Kanagawa Prefecture, China's Anhui Province, and France's Region Nord Pas De Calais. The sister-state programs involve educational exchanges, cultural exchanges, and mutual cooperation in industry and foreign trade."

Nevertheless, many Japanese firms in the Sunbelt produce or assemble television sets, fans, plastic parts, textiles and other items whose production is highly automated or does not require large numbers of experienced and highly trained workers. Thus, communities may not always be able to obtain substantial increases in employment *and* gains in labor productivity and technology as a result of Japanese investment, as is suggested by some of the survey responses.

Labor, of course, is only one of the factors that influence plant-location decisions. The availability of agricultural products was a major factor in Kikkoman's decision to locate its soy sauce plant in Wisconsin, and similar considerations brought seafood processors to Alaska, paper and wood companies to Washington, and cotton thread companies to South Carolina. An existing concentration of firms in the same or related industries (including venture capital and R&D companies) brought Japanese producers of semiconductors, microprocessors and other electronic parts to northern California. Access to major markets offered by a location in New York or Illinois has been a pivotal factor for companies making both consumer and industrial products.

Japanese firms are more likely than are firms from other countries to build, rather than to buy, manufacturing facilities. In recent years however, a growing familiarity with the U.S. market and the size and structure of U.S. industry has made companies slightly more easy with the prospect of buying U.S. plants. The recent $52 million purchase of a Firestone Tire and Rubber plant in Tennessee by Bridgestone Tire and the $150 million investment by Toyota in a joint venture with General Motors to produce autos in a renovated GM plant in California would not likely have occurred 10 years ago, although then the Japanese were not under such intense pressure to limit their auto exports.

Table 3: Industries In Which Japanese Investment Is Desired

Industry	*Number of Times Industry was Mentioned*
"High technology" industries	22
Biotechnology	1
Electronics	9
Computers	1
Robotics	4
CAD/CAM (Computer Assisted Design/ Computer Assisted Manufacturing)	1
Aerospace	1
Transportation equipment	3
Autos or auto parts	8
Motorcycles, bikes	1
Small farm equipment	1
Metals	5
"Heavy industries"	2
Manufacturing	3
"Light" manufacturing	2
Consumer products	3
Chemicals	3
Minerals	1
Plastics	1
Oil	1
Pharmaceutical	4
Agricultural	4
Forest products	2
Food	6
Ocean and marine	2
"Services"	2
Research	2
Banking	1
Insurance	1
Transportation service	1

In Which Industries Is More Investment Sought?

Elected officials want more Japanese-owned business in the U.S., particularly high-technology operations. One-third of the responding officials named "high-technology" as an industry in which Japanese investment is sought. Sixteen responses identified electronics, robotics, biotechnology and so forth, in further specification (see Table 3). It seems likely that responses that identified such industries as auto parts, chemicals, and metals may also have considered a Japanese "high" technology contribution in framing their preferences for Japanese activity.

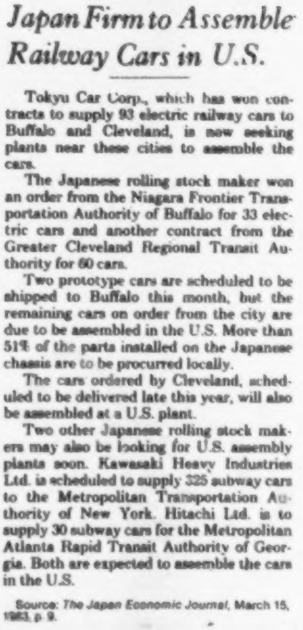
The emphasis on technology appeared in every answer. For example, a Congressman from Wisconsin wrote:

> "I would encourage Japanese investment here, with no ban or restriction on any particular field but with particular encouragement for modern or hi-tech or frontier industries and services."

The Governor of Pennsylvania seeks both output of high-technology "products" and their use in manufacturing processes:

> "In particular, the Commonwealth has been encouraging the establishment of production facilities for advanced technology products by Japanese firms as well as other manufacturing facilities which use advanced technology, such as robots."

When respondents indicate a desire for more advanced technology industries, and also cite technology transfer as one of the benefits of Japanese investment here, they are identifying capital-intensive sectors. Yet nearly every response referred to jobs—employment—as the major benefit sought. *The more automation the Japanese bring the less labor-intensive will be their U.S. operations.* This would be true even of service industries. Moreover,



Japan Firm to Assemble Railway Cars in U.S.

Tokyu Car Corp., which has won contracts to supply 93 electric railway cars to Buffalo and Cleveland, is now seeking plants near these cities to assemble the cars.

The Japanese rolling stock maker won an order from the Niagara Frontier Transportation Authority of Buffalo for 33 electric cars and another contract from the Greater Cleveland Regional Transit Authority for 60 cars.

Two prototype cars are scheduled to be shipped to Buffalo this month, but the remaining cars on order from the city are due to be assembled in the U.S. More than 51% of the parts installed on the Japanese chassis are to be procurred locally.

The cars ordered by Cleveland, scheduled to be delivered late this year, will also be assembled at a U.S. plant.

Two other Japanese rolling stock makers may also be looking for U.S. assembly plants soon. Kawasaki Heavy Industries Ltd. is scheduled to supply 325 subway cars to the Metropolitan Transportation Authority of New York. Hitachi Ltd. is to supply 30 subway cars for the Metropolitan Atlanta Rapid Transit Authority of Georgia. Both are expected to assemble the cars in the U.S.

Source: *The Japan Economic Journal*, March 15, 1983, p. 9.

Japanese firms operating here are likely to be highly automated for another reason: poor quality of workmanship or high wage levels of U.S. workers.[4]

Reasons for investment in the United States, from a *Japanese* point of view, will probably determine the target industries no matter what efforts the states make to influence those choices. One of those (Japanese) inducements is availability of raw materials. Two responses addressed this "pull" effect, differently. One said that investment was wanted in "high-tech industries, agricultural products processing facilities, and forest products processing facilities." The other:

> "We are anxious to attract further Japanese investment. But rather than see more traditional Japanese concentration on raw materials (lumber, wheat and metal products), we would welcome investment in high technology, such as assembly plants for electronic consumer goods, and also in other high-technology 'sunrise' industries."

A clear inducement to the Japanese to invest in U.S. facilities is the avoidance of trade barriers. Whether these are quotas, or "Buy American" restrictions on the purchase of foreign-made equipment, or tariffs, they can be eluded by producing in the United States. Thus "voluntary" quotas on imported, Japanese-made autos created pressure on Honda, Nissan and now Toyota to assemble (if not entirely manufacture) in the United States. Auto parts manufacture will follow, partly because of the possibility of domestic-content legislation that is now before the Congress.[5] Thus the rising incidence of trade restrictions on such products as autos, electronics and steel may force some defensive investments by Japanese manufacturers in U.S. production facilities. This is one of the purposes of the supporters of domestic-content legislation: "It would curb the alarming rise in foreign sourcing by U.S. companies, while inducing foreign-based companies to invest here."[6]

By February, 1983, however, all four of the biggest auto importers (Toyota, Nissan, Honda and Volkswagen) had U.S. production facilities. An unidentified House staff member said to the New York Times: "If the aim of domestic content legislation is domestic production, then this has to mean less steam for the bill."[7]

Modified "Buy American" clauses in local, state and federal contracts might also bring limited Japanese involvement. For example, a subway-car contract might be let to a foreign firm as the lowest bidder, yet contain clauses requiring a certain portion of components or materials, or some assembly, to be made in the United States (see box for example). The forced nature of such arrangements suggests that the life of an investment so generated will be limited to the completion term of the contract. The potential benefits of this kind of investment, then, would not extend to the list in Table 1.

Trade Conflict

Nearly all the elected officials responded that direct investment from Japan helps to reduce trade conflict. Some of positive responses emphasized international understanding. For example:

> "The more we can understand the Japanese, the less conflict there will be. Japanese job-producing investments may serve to encourage U.S.—Japanese ties by creating goodwill in the population."

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[4] Japan External Trade Organization (JETRO), *Japanese Manufacturing Operations in the United States: Results of the First Comprehensive Field Study*, September, 1981.

[5] The Fair Practices in Automotive Products Act (H.R. 1234) would require a specified proportion of the components of autos sold in the United States to be manufactured here.

[6] Statement of Douglas A. Fraser, President of the UAW, before the House Ways and Means Trade Subcommittee on Auto Content Bill, (H.R. 5133), September 21, 1982.

[7] *New York Times*, March 14, 1983, Section D.

Most, however, referred to the economic issues: trade imbalance and U.S. unemployment. Some of these are excerpted below:

> "I feel there is less opposition to Japanese imports when partial manufacture and/or assembly takes place in the United States."

> "More voluntary, direct investment from Japan may be the best way to reduce the serious trade friction between our two countries, and help to avert protectionist legislation that can only be harmful in the long run."

> "Having Japanese goods produced in the United States leads to lower Japanese trade surpluses vis-a-vis the U.S. market. Much of the friction related to the 'theft' of U.S. jobs could be reduced as those jobs would now be in the United States."

> "It's the loss of jobs by Americans, not the trade imbalance, that is so irritating."

A few respondents raised the issue of Japan's import barriers to U.S. goods, for example:

> "Investment could be a factor in reducing trade conflict between the two nations. But one must recognize that equitable trade is a two-way street, and that firms in my district should have an opportunity to compete on an equal footing in Japan's domestic market."

Some reservations about Japanese direct investment were expressed by these legislators. One said:

> "Whether direct investment from Japan reduces trade conflict may depend largely on the financial behavior of the Japanese firms. To the extent that profits earned in the relatively open markets of the United States are repatriated to the Japanese parent companies rather than reinvested here, Japanese investment in the United States may exacerbate trade conflict.[*] This will be true as long as there is disparity between access to investment in the two countries."

Another said that trade conflict would be reduced only if Japanese investment does not "discourage growth of U.S.-owned or controlled industry." One response suggested more information would be useful, when he commented that investment by Japanese would mitigate conflict only "when the benefits of that investment are clearly spelled out and not misunderstood."

One governor cautioned against using protectionist, or other politically inspired moves, to attract capital investment:

> "We would prefer that the investment were made on the basis of sound economic decisions, rather than political ones. This would add much more to the long-term stability of the investments."

Mr. **Walgren**. That is fine. Thank you very much.

We will come back to those subjects that you just raised in some discussion. There is no reason for us not to have a relatively informal exchange. So we appreciate your having approached it that way.

Let's go to the other two members of the panel and then come back for discussion.

We will proceed with Dr. Hill.

[The biographical sketch of Dr. Hill follows:]

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[*] Japanese incorporated affiliates in the United States reinvested 90 percent of their 1981 earnings here. European affiliates reinvested 62 percent; Canadian affiliates, 49 percent. *Survey of Current Business*, August, 1982, Table 5, p. 34.

ROBERT BERNARD HILL

Senior Research Associate and Assistant Director, Bureau of Social Science Research, 1981-present.

Formerly, Director, Research Department, National Urban League, 1972-1981.

Current Research:

Research on Black Families: An Assessment of Empirical Findings and Their Implications for Economic and Social Policies. A project that is being developed in collaboration with Andrew Billingsley, President of Morgan State University and Adjunct Research Associate, BSSR.

Education:

Ph.D. (sociology), Columbia University, 1969.

B.A. (sociology), City College of New York, 1961;

Selected Affiliations and Positions:

Current:

Member, Child and Family Indicators Advisory Group, Social Science Research Council.

Member, National Caucus of Black Aged.

Member, American Sociological Association and Association of Black Sociologists.

Chair, Minority Fellowship Committee, American Sociological Association.

Member, Committee on National Statistics, American Sociological Association.

Past:

Advisory Committee on the Black Population for the 1980 Census, U.S. Bureau of the Census.

Member, Research Technical Committee, White House Conference on the Aged, 1980-1981.

Member, National Advisory Committee, White House Conference on Families, 1979-1980.

Chair, National Research Forum, White House Conference on Families, 1979-1980.

Visiting Professor, Sociology Department, Howard University.

President, Washington, D.C. Sociological Society.

Board of Trustees, LeMoyne College, Syracuse, New York.

Research and Development Committee, National Board of YMCA.

Associate and Assistant Director, Research Department, National Urban League.

National Director, 1970 Census Project, National Urban League.

Research Associate, Bureau of Applied Social Research, Columbia University.

Adjunct Faculty, Princeton University, Morgan State University, Fordham University, New York University.

Consultant, National Advisory Commission on Civil Disorders.

Consultant, Regional Plan Association, New York City.

Consultant, New York City Departments of Welfare and Relocation.

Advisory Committee on Aged and Aging Blacks, U.S. Senate.

Dr. HILL. Thank you, Mr. Chairman.

I am currently senior research associate and assistant director at the Bureau of Social Science Research, Inc., a nonprofit policy research organization directed by Dr. Albert Cantril. Prior to joining BSSR in 1981, I served as the National Urban League's director of research for about a decade. Consequently, I am pleased to have been invited to testify before you on the implications of changing technology for various demographic groups.

I would like to direct my remarks to employment problems that may be exacerbated by the technological revolution for three demographic groups in the work force: women, minorities, and youth. For these groups have traditionally been overrepresented in lower-paying occupations and experience disproportionately high rates of unemployment. But it is from these three groups that the largest influx in the labor force has occurred.

Between 1950 and 1976, women accounted for 60 percent of the 33 million new workers in the labor force, raising their labor force participation rate from 34 percent to 47 percent. Over the same period, youth between the ages of 16 to 24 doubled their numbers in the labor force, from 11.5 to 23 million, and thus accounted for about one-third of the increase in the nation's work force. And the number of blacks in the labor force jumped by 66 percent, from 7 million to 11 million, between 1954 to 1977, compared to an increase of 52 percent among whites.

Labor force projections indicate that the size of these groups is likely to continue to rise in the coming decade, at various rates. By 1990, the U.S. Labor Department projects that there will be about

56.5 million women in the civilian labor force. Thus the proportion of all persons in the labor force who are women is expected to rise from 42 to 46 percent between 1979 and 1990.

However, with the passing of the post-World War II baby boom cohort into middle age, the total number of youth 16 to 24 years old is expected to fall from 24.5 to 22.5 million between 1978 and 1990. But all of this decline will occur among white youth, since the number of black youth is expected to rise from 3 million to about 3.2 million over the same period.

In general, minorities are expected to show dramatic increases in the labor force during the 1980's and 1990's, especially among Hispanics and Asians. Although official labor force projections are not yet available for these groups, their high fertility rates and immigration patterns, both legal and illegal, suggest that it is very likely that minorities may comprise about one-third of the labor force by the 21st century.

According to conventional wisdom, women, minorities and youth are likely to experience serious employment problems because the number of high-paying, professional and skilled occupations in the growth industries of the future will increase, while the number of low-paying, semiskilled, and unskilled jobs will decline markedly. Thus, many observers assert that a serious mismatch is likely to occur between the kinds of jobs that will be available in the future and the lack of appropriate skills, training or educational attainment among women, minorities and youth to compete effectively for those jobs.

Indeed, such a mismatch has a high probability of occurring, assuming that current trends are allowed to run their natural course. But the explanation of this incongruity between supply and demand is contradicted strongly by many studies that have systematically examined the quality of jobs being produced by high growth industries. These analyses reveal that, contrary to popular belief, the number of low-paying, semiskilled, and unskilled jobs is likely to increase in the future, while it is the high-paying professional, and skilled occupations that are likely to experience some decline.

In fact, the industries that experienced the largest gains in employment in recent decades have been those with a concentration of low-paying jobs. According to research by Eli Ginzberg, for example, between 1950 and 1976 total employment rose from 14 to 32 million, twice as fast among the three industries—services, retail trade, and finance, insurance and real estate—with below average weekly earnings than it rose, from 25 to 32 million, among the five industries—mining, construction, manufacturing, wholesale trade, and transportation and utilities—with above average weekly earnings.[1]

Other economic analysts, such as Dorothy Newman, formerly with the U.S. Bureau of Labor Statistics, have also concluded that the bulk of the new jobs created in high growth industries will require less skill, not more:

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[1] Eli Ginzberg, "Good Jobs, Bad Jobs, No Jobs," Cambridge, Mass.: Harvard University Press, 1979, p. 37.

> As early as 1966, studies prepared by the U.S. National Commission on Technology, Automation and Economic Progress, showed that, while technological change created many new types of jobs, most of the new jobs had low skill requirements. High complex equipment does not usually need highly-skilled operators. The skills are built into the machines.[2]

Similarly, Levin and Rumberger contend:

> Neither will the high-tech transformation of existing jobs create demands for increasingly sophisticated work skills.
>
> But there is little evidence that these jobs will require workers with more sophisticated skills. To the contrary, studies suggest that the new technologies provide opportunities to further simplify and routinize work tasks and to reduce the opportunities for worker individuality and judgment.[3]

Finally, according to the U.S. Labor Department's projections, the largest number of new jobs in the future will occur among low-paying and not high-paying occupations. For example, while the number of computer specialist jobs is expected to increase by 365,000 between 1978 and 1990, six times as many, or 2.3 million, new jobs are projected for janitors, nurse's aides, and orderlies, waiters and waitresses and fast food service workers.[4] But these are the low-paying service jobs in which women, minorities, and youth are already overconcentrated. Thus, I perceive as the more ominous problem not that of a mismatch but of too perfect a fit.

If the number of low-paying jobs is permitted to increase at the expense of high-paying jobs in high growth industries, it will have serious ramifications for persons in all economic, educational, sex, and ethnic strata in this Nation. Such trends would result in more polarized dual labor markets in which high-paying, primary jobs are held disproportionately by white males, while low-paying, secondary jobs are held largely by minorities, women, and youth. Such polarization is likely to exacerbate class, racial, and sex cleavages throughout this country.

As a way of trying to prevent such occupational polarization, I would like to offer the following recommendations:

One, that the legislative and executive branches of the Federal Government monitor very carefully the relative growth in the number of primary and secondary jobs being produced by expanding industries;

Two, that special economic incentives be provided the private sector as an inducement for creating a disproportionate number of high-paying, primary jobs;

Three, that intensive educational, training, and retraining efforts be targeted to women, minorities, and youth in order to accelerate the development of skills that will greatly enhance their chances for moving into the high-paying, primary jobs in our economy.

[The prepared statement of Dr. Hill follows:]

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[2] Dorothy K. Newman, et al., "Protest, Politics, and Prosperity: Black Americans and White Institutions, 1940–1975," New York: Pantheon Books, 1978, p. 75. Also see Robert B. Hill, "Discrimination and Minority Youth Employment," Waltham, Mass.: Center for Public Service, 1980.

[3] Henry M. Levin and Russell Rumberger, "High-Tech Requires Few Brains," Washington Post, Jan. 30, 1983. Also see Richard McGahey, "High Tech, Low Hopes," New York Times, May 15, 1983.

[4] Max L. Carey, "Occupational Employment Growth Through 1990," Monthly Labor Review, vol. 104, No. 8, August 1981, pp. 42–55.

STATEMENT

of

Robert B. Hill, Ph.D.
Sr. Research Associate
Bureau of Social Science Research, Inc.
Washington, D.C.

on

"Technology and Employment:

Demographics of the Work Force"

before

Subcommittee on Science, Research and Technology
Committee on Science and Technology
U.S. House of Representatives

and

Task Force on Education and Employment
Budget Committee
U.S. House of Representatives

June 10, 1983

My name is Robert B. Hill and I am Senior Research Associate/ Assistant Director at the Bureau of Social Science Research, Inc, a non-profit policy research organization directed by Dr. Albert H. Cantril. Prior to joining BSSR in 1981, I served as the National Urban League's Director of Research for about a decade. Consequently, I am pleased to have been invited to testify before you on the implications of changing technology for various demographic groups.

I would like to direct my remarks to employment problems that may be exacerbated by the technological revolution for three demographic groups in the work force: women, minorities and youth. For these groups have traditionally been overrepresented in lower-paying occupations and experience disproportionately high rates of unemployment. But it is from these three groups that the largest influx in the labor force has occurred.

Between 1950 and 1976, women accounted for 60 percent of the 33 million new workers in the labor force, raising their labor force participation rate from 34 percent to 47 percent. Over the same period, youth between the ages of 16-24 doubled their numbers in the labor force (from 11.5 million to 23.0 million) and thus accounted for about one-third of the increase in the nation's work force. And, the number of blacks in the labor force jumped by 66 percent (from 7 million to 11 million) between 1954-77, compared to an increase of 52 percent among whites.

Labor force projections indicate that the size of these groups is likely to continue to rise in the coming decade, at various rates. By 1990, the U.S. Labor Department projects that there will be about 56.5 million women in the civilian labor force. Thus, the proportion of all persons in the labor force who are women is expected to rise from 42 percent to 46 percent between 1979 and 1990.

However, with the passing of the post-World War II "baby boom" cohort into middle-age, the total number of youth, 16-24 years old, is expected to fall from 24.5 million to 22.5 million between 1978 and 1990. But all of this decline will occur among white youth, since the number of black youth is expected to rise from 3.0 million to about 3.2 million over the same period.

In general, minorities are expected to show dramatic increases in the labor force during the '80's and'90's, especially among Hispanics and Asians. Although official labor force projections are not yet available for these groups, their high fertility rates and immigration patterns (both legal and illegal) suggest that it is very likely that minorities may comprise about one-third of the labor force by the 21st Century.

A Mismatch?

According to conventional wisdom, women, minorities and youth are likely to experience serious employment problems, because the number of high-paying, professional and skilled occupations in the growth industries of the future will increase, while the number of low-paying, semi-skilled and unskilled jobs will decline markedly. Thus, many observers assert that a serious mismatch is likely to occur between the kinds of jobs that will be available in the future and the lack of appropriate skills, training or educational attainment among women, minorities and youth to compete effectively for those jobs.

Indeed, such a mismatch has a high probability of occurring--assuming that current trends are allowed to run their natural course. But the explanation of this incongruity between supply and demand is contradicted strongly by many studies that have systematically examined the quality of jobs being produced by high growth industries. These analyses reveal that, contrary to popular belief, the number of low-paying, semi-skilled and unskilled jobs is likely to increase in the future, while it is the high-paying professional and skilled occupations that are likely to experience some decline.

In fact, the industries that experienced the largest gains in employment in recent decades have been those with a concentration of low-paying jobs. According to research by Eli Ginzberg, for example, between 1950 and 1976, total employment rose (from 14 million to 32 million) twice as fast among the three industries (services, retail trade and finance, insurance and real estate) with below average weekly earnings than it rose (from 25 million to 32 million) among the five industries (mining, construction, manufacturing, wholesale trade and transportation and utilities) with above average weekly earnings. 1/

Other economic analysts, such as Dorothy Newman, formerly with the U.S. Bureau of Labor Statistics, have also concluded that the bulk of the new jobs created in high growth industries will require less skill, not more:

> As early as 1966, studies prepared by the U.S. National Commission on Technology, Automation and Economic Progress showed that, while technological change created many new types of jobs, most of the new jobs had low skill requirements...Highly complex equipment does not usually need highly skilled operators. The "skills" are built into the machines. 2/

Similarly, Levin and Rumberger contend:

> Neither will the high-tech transformation of existing jobs create demands for increasingly sophisticated work skills...
>
> But there is little evidence that these jobs will require workers with more sophisticated skills. To the contrary, studies suggest that the new technologies provide opportunities to further simplify and routinize work tasks and to reduce the opportunities for worker individuality and judgment. 3/

Finally, according to the U.S. Labor Department's projections, the largest number of new jobs in the future will occur among low-paying and not high-paying occupations. For example, while the number of computer specialist jobs is expected to increase by 365,000 between 1978 and 1990, six times as many (or 2.3 million) new jobs are projected for janitors, nurses aides and orderlies, waiters and waitresses and fast food service workers. 4/ But these are the low-paying service jobs in which women, minorities and youth are already over-concentrated. Thus, I perceive as the more ominous problem, not that of a mismatch, but of too perfect a fit.

If the number of low-paying jobs is permitted to increase at the expense of high-paying jobs in high growth industries, it will have serious ramifications for persons in all economic, educational, sex and ethnic strata in this nation. Such trends would result in more polarized dual labor markets in which high-paying, primary jobs are held disproportionately by white males, while low-paying, secondary jobs are held largely by minorities, women and youth. Such polarization is likely to exacerbate class, racial and sex cleavages throughout this country.

Recommendations

As a way of trying to prevent such occupational polarization, I would like to offer the following recommendations:

1. That the legislative and executive branches of the Federal Government monitor very careful the relative growth in the number of primary and secondary jobs being produced by expanding industries.
2. That special economic incentives be provided the private sector as an inducement for creating a disproportionate number of high-paying, primary jobs.
3. That intensive educational, training and retraining efforts be targeted to women, minorities and youth in order to accelerate the development of skills that will greatly enhance their chances for moving into the high-paying , primary jobs in our economy.

Thank you very much.

Mr. **Walgren**. Thank you very much, Dr. Hill, for some interesting points.

And next, Dr. Rumberger.

[The biographical sketch of Dr. Rumberger follows:]

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Russell W. Rumberger is a Senior Research Associate at the Institute for Research on Educational Finance and Governance (IFG), School of Education, Stanford University. He received his B.S. in Electrical Engineering (specializing in computer systems) from Carnegie-Mellon University, his M.S. in Economics from Stanford University in 1978, and his Ph.D. in Education from Stanford University in 1978. Prior to his present position Rumberger was a Senior Research Associate at The Ohio State University. He has served as a consultant to the International Institute for Educational Planning of UNESCO, Paris; the Inter-American Development Bank; and the State of California. He has published numerous articles in scholarly journals on education and labor markets. In addition he is author of Overeducation in the U.S. Labor Market (Prager, 1981) and co-author (with Martin Carnoy and Derek Shearer) of A New Social Contract: The Economy and Government After Reagan (Harper and Row, 1983).

Dr. **Rumberger**. Thank you, Mr. Chairman.

I guess a little bit of my suspense has just been taken from my talk, but that is all right. I will try to talk about some other things that are related.

I would like to talk about demographics, which is what this particular panel is supposed to discuss, in terms of education, training, and skills. It really relates to the larger charge of the committee, which is to look at technology and employment. I would like to discuss two concerns:

First, how technology will affect the level and composition of future employment in this country, and second, how these trends are likely to result in increasing disparities between the education and skills of the future American work force, on the one hand, and the number and skill levels of future jobs on the other.

I would like to point out these views reflect the thinking of me and my colleague, Henry Levin, professor at Stanford University.

I think, in general, there is a widespread view, that technology, specifically high technology, will dominate future job growth. And another conventional view related to this is that technology will upgrade the requisite skill levels of jobs in our economy.

For example, more and more people will be working with computers and therefore people will have to have computer skills or computer-related skills to be working with these kinds of advanced technology. Our view is somewhat different, and it really disputes these conventional views. There are three points to our view.

First of all, most employment growth will not take place in high technology areas. As Dr. Hill points out, the BLS projections really show there is going to be much more growth in service-related, low-paying, low-skill areas in the economy than in high technology areas. And since he quoted some statistics, I don't have to do that.

The second part of our view, which is more profound but really more important, is that, based on the way technology has been implemented in the past, we believe that future technology is likely to reduce the skill levels of many existing jobs.

Sophisticated technologies do not necessarily require workers with sophisticated skills. Computer software has become increasingly user-friendly, so people don't have to know anything about computers to use computers in their jobs. Apple, makers of the new LISA computer, claims in their advertisement that in 20 minutes they can take someone who has never used a computer before and teach them to perform a lot of sophisticated office functions, such as word processing, filing, and printing. There are many other examples where we can see that technology does not necessarily require workers with increased skill levels.

This same claim, by the way, has been made in the past—the conventional view that technology will upgrade the skill levels of jobs. Those claims were investigated, in part, through the National Commission on Technology, Automation, and Economic Progress. And the results of that study and of other studies that we have examined thus far, seem to indicate that technology, the way it is normally applied in the workplace, has a tendency to lower skill levels.

In the past many of the machine technologies displaced physical effort in jobs. Future technologies grounded in the microelectronics revolution are likely to displace mental effort in jobs. And that is why we are very concerned.

The third aspect of our view is that technology is also likely to destroy more jobs than it creates.

There are many areas that we can now observe where technology is displacing workers. The one that has probably received the most attention in the press is robotics. Right now the United States has far fewer robots than Japan. But more robots will be employed in the future. Some studies at Carnegie-Mellon University suggest that robots could conceivably replace between 3 and 8 million workers in the next 40 years or so.

There are other examples that I can cite. One of the newest ones is in the case of automatic teller machines. I just read in the paper recently that in San José they now have a bank that has no human tellers, just automatic tellers. And they foresee that as the bank of the future.

The part that is perhaps most disturbing about this trend is that displacement is likely to occur more in the middle and upper middle occupational areas as opposed to the low occupational areas. I think the major reason is because of costs. Employers have much more incentive to employ technology to displace workers who have high wages than they do to use technology to displace workers with low wages. So there will always be a lot of jobs for people to work at McDonald's, but we see robots and other technologies being employed to displace steel and automobile workers who have very high wages.

So we believe that in general the impact of technology is going to be to eliminate more of the jobs in the middle and upper middle ranges. It is interesting that in Kurt Vonnegut's book, "Player Piano," written in 1952, he envisioned a future society dominated by a small cadre of engineers and managers, and with most of the production being done by machines, and then the majority of the people were not employed. There was some public service employment in a general sense in his future society. But most people, in fact, did not work.

There were a lot of ramifications that he explored in his book. It is interesting that that book was written 30 years ago, and in fact we may be moving in that direction as he envisioned it.

Of course, technology does create jobs as well as destroy them. The manufacturing firms that produce robots, service robots, and sell robots, for example, create jobs. The real question then is, What is the net effect of these changes: Are more jobs going to be created than are destroyed?

Frankly, I don't have an answer to that question. We are in the process of conducting a study on that. But I think it is safe to say that technology does create jobs as well as destroy them and the real issue is, does it create more jobs than it destroys?

The other aspect of job displacement related to technology that is also disturbing is the movement of production overseas. The recent announcement of Atari to displace 1,700 workers in Silicon Valley, which is supposed to be one of the hot spots of high technology, is quite disturbing and illustrates to us a growing trend to move more jobs from American soil to overseas with workers at much lower pay and workers with much less education.

On the optimistic side to this rather dismal scenario about displacement, if these changes could improve the competitive position of American firms in the world economy and subsequently increase their sales, then the argument goes that these firms will become healthier as their sales increase and that they will hire more workers in other fields. The argument depends on the assumption that these changes will generate subsequent growth in these firms.

As a result of these trends, we see a number of disparities in the future. One of them is that there is always, of course, going to be shortages in specific occupational areas, such as the current shortages of engineers in certain specializations, and computers specializations. Intermittent shortages will always exist in the future. But, we foresee two more serious kinds of disparities:

One of them is unemployment, and to the extent that technology creates more unemployment, that is a serious problem. Specifically, are there going to be enough jobs in our future economy for everyone who wants to work?

The other one that is maybe less evident, but we feel is equally serious, is underemployment: that a growing number of workers will be forced to accept jobs incommensurate with their education and training. That, too, we feel has serious implications.

Already I have found in my own research that between 25 and 35 percent of recent college graduates are underemployed. As of 1980, more than one out of every five young women was employed as a secretary or in clerical jobs. I would hardly say that is effectively using a college education.

The ramifications of the problems of underemployment and people being underemployed in their jobs was identified long ago by Adam Smith, more than 200 years ago, who said:

> The man whose life is spent in performing a few simple operations, of which the effects, too, are perhaps always the same or very nearly the same, has no occasion to exert his understanding or to exercise his invention in finding out expedients for removing difficulties which never occur. He naturally loses, therefore, the habit of such exertion and generally becomes as stupid and ignorant as is possible for a human creature to become.

To end this presentation, I would just like to point out that the future is not inevitable. Technology will impact employment in the future, perhaps more widely and at a faster pace than it has in the past. Maybe there is a certain type of inevitability in the types of technologies that are developed in our future, but the impact of the technologies will depend on how they are employed, and the possible disparities will depend on the amount and type of education and training acquired by future American workers.

Thank you.

[Materials submitted by Mr. Rumberger follow:]

THE FUTURE IMPACT OF TECHNOLOGY ON WORK SKILLS

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May 1983

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> During the war...the Second Industrial Revolution...managers and engineers learned to get along without their men and women...It was the miracle that won the war--production with almost no manpower...Machines were doing America's work far better than Americans had ever done it. There were better goods for more people at less cost, and who could deny that that was magnificent and gratifying?...Now you people have engineered them out of their part in the economy, in the market place, and they're finding out--most of them--that what's left is just about zero...Maybe the actual jobs weren't being taken from the people, but the sense of participation, the sense of importance was.
>
> Kurt Vonnegut, Jr., Player Piano, 1952

There is little doubt that technology will profoundly affect jobs in the future. Current technologies in biomedical engineering, computer design, and communications have already altered work in a variety of settings. The September 1982 issue of Scientific American documented how work in agriculture, transportation, offices, and even design have already been transformed significantly by technological advances. Future breakthroughs, especially in micro-electronics, will bring even more changes and further spread the impact of high technology.

There is much more uncertainty about how technology will affect the number and composition of jobs in our future economy. Many business leaders, government officials, and citizens believe that an increasing number of jobs will be in high technology occupations, such as engineering and computer fields. Robots and similar devices will eliminate some of the more mundane and boring jobs in society, freeing workers for more rewarding and creative jobs. And since more and more jobs will involve the use of computers and other highly sophisticated technical products, the skill requirements of jobs will generally be higher than they are today. As a result, future workers will need more education and training to acquire these skills.

Despite the popularity of these beliefs, available evidence does not support them (Levin and Rumberger in press). Recent employment projections by the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor show that many more jobs will be created in low-skilled service occupations than in high-skilled professional ones. Between 1978 and 1990 the BLS projects more than 600,000 new jobs for janitors and sextons, compared to 200,000 new jobs for computer systems analysts; and 800,000 jobs for fast food workers and kitchen helpers, compared to 88,000 jobs for computer operators (Carey 1981). While occupations in high technology areas will grow by 45 percent between 1980 and 1990--almost three times as fast as employment growth overall--they will generate only 7 percent of the new jobs (Coleman 1982). Just twenty occupations will generate 35 percent of new jobs during the 1980s and not one relates to high technology. In fact, only two of those jobs--elementary school teachers and accountants--require a four-year college education.

Of course these figures are only estimates. But they are based on sophisticated, econometric techniques that are constantly revised by the BLS to reflect new advances and information (see Oliver 1982). What they fail to show, however, is how technology will affect jobs in the future, particularly the skill levels of jobs. In the remainder of this paper we will speculate on how technology is likely to impact of the number and composition of jobs in our future and why. We will then discuss the social implications of these changes.

Technology and Jobs

Technology will affect the number of jobs in our future economy as well as the skill composition of jobs. Both of these impacts are important. Some people fear that robots and other devices will eliminate an increasing number of jobs in our future economy. Others fear that the impact of technology on existing jobs will be equally disastrous by removing much of the discretion and creativity from jobs, leaving workers to simply monitor and respond to the demands of their machines. How likely are these fears to be realized?

The Number of Jobs. Technology will eliminate jobs, but it will also create jobs. The important issue is whether it will create more jobs or fewer jobs than it eliminates. One difficulty in addressing this issue is that the jobs created are frequently in different industries than the jobs eliminated.

Consider the case of robots. Robots have been used primarily to replace operative positions in manufacturing industries, such as automobiles and steelmaking (Ayres and Miller 1983). One estimate suggests that robots could replace up to 3 million operative jobs during the next 20 years and eliminate all 8 million operatives by 2025 (Ayres and Miller 1982). But the increasing use of robots will create jobs in those industries involved in their design, development, production, and maintenance. Another recent estimate suggests that robots will eliminate 100,000 to 200,000 jobs by the year 1990, while creating

32,000 to 64,000 new jobs (Hunt and Hunt 1983). Thus it appears that one major technology has the potential to eliminate more jobs than it creates.

In order to assess the net impact of technological changes on the level of employment one must account for the effect of economic growth. Economic growth creates jobs. So even if technology has the potential to eliminate more jobs than it creates, economic growth could produce enough new jobs to offset this tendency. Yet with the number of unemployed currently so high--12 million persons at the end of 1982--the economy would have to sustain a long period of high growth to both reduce the current level of unemployment and offset future displacement due to technology. Recent government forecasts suggest unemployment will remain high for the next five years even without further displacement (U.S. President 1983; U.S. Congressional Budget Office 1983). So while economic growth may help to offset the displacement effects of technology, there is no assurance that the requisite levels can be attained in the near future.

Another threat from technology is that it may facilitate the movement of production from the United States to other countries. Even high-technology firms themselves are not immune to this development, as the recent announcement of 1700 layoffs by Atari demonstrates (Washington Post, February 27, 1983). Technological developments in production, even sophisticated electronics products, now permit these processes to be carried on by workers in other countries who receive much lower wages--$ 1 per hour versus $9 per hour--and have much less education--5 years versus 12 years--than American workers (San Jose Mercury News, February 28, 1983). Future technologies could accelerate this tendency.

The Types of Jobs. It is not only important to consider how technology will affect the level of employment in our future economy, but also the types of jobs in the economy. First, will the jobs created by technological advances be more skilled or less skilled than the jobs eliminated? Second, will the impact of technology on existing jobs tend to raise or lower requisite work skills?

It is unlikely that technology will ever eliminate the most skilled, creative, and demanding forms of work in our future economy. Yet technology is unlikely to eliminate the least skilled and most mundane jobs in our economy either, at least in the near future. It is much more profitable for companies to employ new technologies to eliminate jobs that pay $12 per hour than it is to replace jobs that pay the minimum wages of $3.35 per hour. Robots, for example, have been used primarily to replace operatives whose earnings are well above the minimum wage.

Other examples also suggest that technology is most likely to eliminate middle-level, skilled and semi-skilled jobs. A series of technological advances in the printing industry, from machine typesetting to computer-aided, phototypesetting techniques, have eliminated large number of skilled, craft jobs for composers and typesetters (Zimbalist 1979a). Automatic teller machines are eliminating jobs for bank tellers. And computer-aided design (CAD) may soon eliminate the 300,000 current positions for drafters (Gunn 1982).

It is much more difficult to predict the types of jobs that will be created as a result of these changes. Many of the new jobs will be in high-technology firms where these new products are designed, developed, and produced. While high-tech industries do employ a larger proportion of engineers, computer specialists, and other high-level, technical workers than other industries, the majority of jobs in these industries are at the semi-skilled level--operatives, clerical workers, and managers. Further, high-tech industries are only expected to generate about 5 percent of all new jobs between 1980 and 1990 (U.S. Bureau of Labor Statistics 1982). Thus it appears that the skill levels of jobs created through the increasing use of technology in the workplace will not differ significantly from the jobs eliminated. To the extent that jobs in high-tech industries themselves become less skilled because of technology, then the net impact of technological change will be to lower skill levels.

The impact of technology on existing jobs will be much more important in determining the skill requirements of jobs in our future economy than the jobs created and lost through technology. Of course technology alone does not change the skill requirements of jobs. It also depends on how the tasks associated with jobs are changed. As Adam Smith first recognized in The Wealth of Nations over 200 years ago and Charles Babbage more carefully documented 50 years later, if job tasks are fragmented into their respective parts, employers can hire less-skilled workers to perform the simpler tasks and pay them lower wages than workers who perform the more complex, skilled tasks (Braverman 1974, pp. 77-83). As a result of fragmentation, some jobs become "deskilled."

Technology can aid this process as machines take over some of the tasks formerly performed by workers. The assembly line developed by Henry Ford was based on the principle of job fragmentation--some workers assembled one portion of the car while other workers assembled other portions. The introduction of machinery automated some aspects of the process, such as the movement of the automobiles down the line (Gartman 1979). Automation also allows employers to better control the production and work process (Braverman 1974, p. 195).

One way to predict how technology will affect the skill levels of jobs in the future is to examine how technology affected the skill levels of jobs in the past. A number of studies have examined the implementation of past technological innovations on the skill requirements of jobs. One of the most thorough of these was conducted by James Bright, a professor at Harvard University. Bright examined the impact of automation in a variety of U.S. manufacturing firms during the 1950s. With increasing levels of automation he observed that the skill requirements of jobs first increased and then decreased as many formerly skilled workers were simply required to tend machines (Bright 1958). Other studies support the conclusion that past technological innovations have tended to reduce the skill requirements of jobs (e.g., Zimbalist 1979b). Moreover, the skill requirements of jobs in the U.S. economy as whole appear to have changed very little over the last 20 years despite the growth of professional and technical employment (Rumberger 1981a).

Present and future technologies promise the same impact. Computers, for example, have become easier and easier to use. Early computers were initially programed in machine languages that required extensive training. Since that time computer software has become increasingly "user-friendly" so that people can use computers with little or no computer background. A recent sales ad for the new LISA computer claims that workers can use the system with only 20 minutes of training. Current systems available with a "mouse" cursor and future systems commanded by voice may soon eliminate the need for most keyboard functions.

While early technologies primarily displaced physical labor, computers and other electronic technologies threaten to displace mental labor and thereby reduce requisite work skills. Word processors now correct spelling mistakes and hyphenate words, thereby eliminating the need for those skills in secretaries. Computer-aided machines can now diagnose many of the problems that develop in these products, thereby reducing the requisite knowledge and skills of repair technicians. There appears to be virtually no area of work where computers cannot take over some of the mental tasks and make the judgements that were formerly the domain of individual workers. Computers also offer employers better ways of controlling the work process and monitoring the output of their employees (Wall Street Journal, May 6, 1983).

Social Implications

One implication of these changes is that our future economy may not be able to fully employ all those who wish to work. Similar fears were expressed during widespread automation of U.S. manufacturing firms during the 1950s. Those fears turned out to be unfounded as the United States experienced rapid and sustained economic growth during the 1960s. Yet the uneven economic growth of the last 10 years at least cautions against too much optimism over our country's ability to achieve the high growth rates of the past. Moreover, the future impact of technology on the work place is likely to be much more widespread than past changes, increasing the potential for job displacement. If our economy is unable to generate sufficient jobs in the future, then our present system of distributing income based on work may have to be revised (Leontiff 1982).

Another implication of these changes is that work may become increasingly repetitious and boring in more and more jobs. Adam Smith (1937) not only recognized the rationale for fragmenting jobs, but also the result:

> The man whose life is spent in performing a few simple operations, of which the effects too are, perhaps, always the same, or very nearly the same, has no occasion to exert his understanding, or to exercise his invention in finding out expedients for removing difficulties which never occur. He naturally loses, therefore, the habit of such exertion, and generally becomes as stupid and ignorant as it is possible for a human creature to become (p. 734).

Similar concerns were expressed in the government-initiated, Work in America, that appeared 10 years ago (U.S. Department of HEW 1973).

Declining skill levels of jobs is particularly troublesome in the U.S. because education attainments, and hence skill levels, of the American work force are moving in the opposite direction. Currently, more than one out of every four young workers entering the labor market has completed 4 or more years of college (Rumberger in press). As young workers with more schooling continue to replace older workers with less schooling, the average education level of American workers will continue to increase. Underemployment among college graduates is already widespread and will get worse even without further reductions in the skill levels of jobs (Rumberger 1981b). Workers whose skills are underutilized display higher levels of job dissatisfaction and may be less productive as a result (Rumberger 1981b, Chapter 5). This not only poses a problem for individual employers, but for the country as a whole.

While the influence of technology on work is inevitable, its impact on the level and composition of jobs in our future economy is not. The influence of technology will depend on what technologies are developed, but its impact will depend on how it is employed. And that, in turn, depends on who controls the technology. Computer-generated medical diagnosis, for example, is unlikely to displace the need for physicians or their high status in the work world because they can control how this technology is employed. Most workers cannot. In most cases employers determine how a particular technology will be employed and whom it will affect. Increasingly unions have recognized the importance of bargaining with management over the use and impact of technology. The issue is likely to become more important in the future, especially as the threat of displacement becomes more apparent.

To the extent that the workers affected by technology can help determine how it is employed, than some of the negative consequences may be mitigated. But even that may not be enough. The widespread influence of technology may require that all citizens become involved in setting policies over its use (Walton 1982).

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THE EDUCATIONAL IMPLICATIONS OF HIGH TECHNOLOGY

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The research activity of the Institute is divided into the following program areas: Finance and Economics; Politics; Law; Organizations; and History. In addition, there are a number of other projects and programs in the finance and governance area that are sponsored by private foundations and government agencies which are outside of the special R&D Center relationship with NIE.

Abstract

Many business leaders, government officials, and educators believe that high technology will dominate America's economic future, will upgrade the skill requirements of future jobs, and will require a transformation of our educational system to meet these needs. Despite the popularity of these beliefs, available evidence contradicts them: the expansion of the lowest skilled jobs in the American economy will vastly outstrip the growth of high technology ones; and the proliferation of high technology industries and their products is far more likely to reduce the skill requirements of jobs in the U.S. economy than to upgrade them. Nonetheless, the educational system should strengthen the analytical and communicative skills of students, not because of the needs of high technology, but because such skills will help them deal with the changing political, economic, social, and cultural institutions they will face in their adult lives.

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New advances in technology—in genetic engineering, in robotics, and particularly in computers—are transforming the lives of Americans in the home and the workplace. While the micro-computer has signalled the arrival of "high-technology" in the home, many observers believe that its influence in the workplace will be even more profound. Not only do industries producing micro-processors, robots, and the fruits of bio-technology promise rapid growth in sales and employment, but micro-computers and robots are also expected to transform other industries and occupations throughout the economy. One observer predicted that 40 to 50 percent of all American workers will be using electronic terminals by 1990 (Giuliano 1982, p. 152).

Government leaders, Republican and Democrat alike, see the growth of high-technology as one key to solving America's current economic problems. As President Reagan said in his State of the Union Address on January 25, 1982:

> ...as surely as Americans' pioneer spirit made us the industrial giant of the 20th century, the same pioneer spirit today is opening up another vast frontier of opportunity—the frontier of high technology. In conquering this frontier, we cannot write off our traditional industries, but must develop the skills and industries that will make us a pioneer of tomorrow.

Business leaders have echoed this sentiment, calling on the educational system to make the changes necessary to provide enough skilled workers to fuel the growth of high technology. As Steven Jobs, co-founder of Apple Computer, recently stated in a speech at Stanford University: "A massive retraining effort by government and private industry could alleviate the problem of job skill obsolescence created by the expanding computer industry" (Stanford Daily 1983).

Policymakers have proposed vast changes in the educational system to respond to these challenges. The proposed changes are based on the belief that our high-technology future will require workers with more sophisticated job skills. A recent publication from the Education Commission of the States (1982) exemplifies this widespread belief:

> Occupational growth throughout the 1980s is projected to expand most rapidly in the higher-skilled, technical occupations. Tomorrow's workers will likely need improved skills in the selection and communication of information. Many of today's skills considered to be of a "higher" level are the potential basic skills of tomorrow (p. 1).

Such beliefs have prompted proposals to upgrade math and science education in our nation's secondary schools, to place computers in all elementary and secondary schools, and to generate $1 billion in new support for high-technology education (Botkin, Dimancescu, and Stata, 1983).

These beliefs are based on two assumptions. First, future job growth in the United States will favor professional and technical level jobs--such as engineers and computer programmers--that require considerable education and sophisticated training in computer-related areas. Second, high technology will upgrade the skill requirements of existing jobs because workers in those jobs will work increasingly with technologically sophisticated equipment, such as computers.

Despite the widespread propagation of these assumptions, both are contradicted by available evidence. Most new jobs will not be in high technology occupations, nor will the application of high technology in existing jobs require a vast upgrading of the skills of the American labor force. To the contrary, the expansion of the lowest skilled jobs in the American economy will vastly outstrip the growth of high technology ones. And the proliferation of high technology industries and their products is far more likely to reduce the skill requirements for jobs in the U.S. economy than to upgrade them.

In the remainder of this paper we will examine the two common assumptions about high technology and the supporting evidence in greater detail. We will then discuss the educational implications of our high-technology future.

Future Employment Growth

To what degree will high technology jobs dominate future employment growth? Accurate predictions on the composition of future employment depend on the analysis of many factors. These include such influences as economic growth, labor force demography, foreign trade movements (many of which are influenced by changes in international exchange rates), technological breakthroughs, and decisions of multi-national organizations with respect to the international rationalization of production. Many of these factors are difficult to predict because they are subject to political and economic vagaries on a world scale.

While no methodology is likely to provide completely accurate results, those that consider a large number of pertinent influences are likely to be superior to simple extrapolations or other uncomplicated projections. In this respect, the estimates of the Bureau of Labor Statistics (BLS) of the U. S. Department of Labor represent some of the most refined attempts to project the growth and composition of future employment.

Since the 1960s BLS has periodically conducted a series of projection studies based on an economic growth model. Over the last two decades "the methodology has been continually modified to include greater industrial detail, other models, more rigorous analytical techniques, a more automatic system for processing calculations, and broader coverage including labor force and occupations in the current version" (Oliver 1982, p. 1). The methodology incorporates several assumptions about growth in the labor force, economic output, and productivity. Further, to allow for uncertainty, recent projections--for the year 1990--are based on three different scenarios regarding the growth of these various factors. The more optimistic projections assume high growth rates in economic output and productivity, while the more conservative projections assume lower growth rates.

The employment projections are based on occupational employment patterns within detailed industries in 1978, projected employment patterns within these industries in 1990, and projected total employment within each industry based on the economic projections. It is important to note that employment growth refers only to new jobs added to the economy rather than job openings. Job openings will be much higher. BLS estimates that employment growth will account for only one-third of total job openings between 1978 and 1990 (excluding openings due to workers' changing jobs), with the remaining two-thirds due to the replacement of workers in existing jobs who withdraw from the labor force because of death, retirement, or other reasons (U.S. Bureau of Labor Statistics 1980, p. 6).

We will limit our discussion to employment growth resulting from projected creation of new jobs using the BLS figures based on assumptions of modest growth rates. According to these figures, employment will increase by 22 million or 23 percent between 1978 and 1990 (Table 1). The fastest growing job categories in relative terms--percentage change between 1978 and 1990--include several high technology areas. This projected expansion apparently has led to the commonplace assumption that aggregate job growth will be biased toward high technology occupations. Of the five fastest growing occupations, three--data processing machine mechanics, computer systems analysts, and computer operators--deal with high-technology products. Employment in these five occupations is projected to increase by over 100 percent, more than four times the employment growth rate in all occupations.

Such percentage changes are misleading, however. The total number of new jobs generated in these and other high technology occupations will be vastly outweighed by employment growth in other areas. Slower-growing occupations with a large employment base are expected to contribute far more jobs to the economy than high technology occupations. Of the 20 occupations expected to generate the most jobs in the economy during this period, not one is related to high technology. As Table 1 shows, the five occupations expected to produce the most new jobs are all in low skilled areas: janitors, nurses' aides, sales clerks, cashiers, and waiters and waitresses. These five jobs alone will account for 13 percent of the total employment growth between 1978 and 1990. Only 3 or 4 of the "top 20" occupations in terms of total contribution to job growth require education beyond the secondary level, and only two require a college degree (teaching and nursing).

This picture is further reinforced by examination of individual high technology job categories. While jobs for computer systems analysts will increase by over 100 percent between 1978 and 1990, only 200,000 new jobs will be created. In contrast, there will be over 600,000 new jobs for janitors and sextons. In fact, more new jobs for janitors will be created than new jobs in all the five occupations with the highest relative growth rates. Consider another example: about 150,000 new jobs for computer programmers are expected to emerge during this 12 year period, a level of growth vastly outpaced by the 800,000 new jobs expected for fast food workers and kitchen helpers.

Employment growth for the economy as a whole will favor low and middle level occupations. While employment in professional and technical occupations is expected to increase by 20 percent for the twelve year period, this growth rate is lower than in either of the two preceding decades (Table 2). Employment in all professional and managerial occupations increased by 36 percent between 1960 and 1970, and 45 percent between 1970 and 1980. But it is projected to increase by only 28 percent between 1978 and 1990. Clerical and service occupations will account for 40 percent of the employment growth during this period.

Revised BLS estimates show that high technology occupations, as a group, will account for only 7 percent of all new jobs between 1980 and 1990 (Coleman 1982). BLS forecasts are further supported by other government analyses, such as those by the Department of Defense (Choate 1983).

In summary, government estimates suggest that employment growth will favor jobs that require little or no training beyond the high school level. Although employment in high technology occupations will increase quickly in percentage terms over this decade, the contribution of these jobs to total employment growth will be quite small.

The Impact of Technology on Existing Jobs

While the growth of high technology occupations will not have a major impact on overall employment growth in the foreseeable future, high technology will have a profound impact on many jobs in the economy. Increasingly workers in a variety of work settings will find their jobs altered by sophisticated computer technologies. Secretaries will work with word processing equipment; bookkeepers will use computerized, financial spread sheets; clerical workers in purchasing and inventory will apply their skills to automated and computerized record systems; mechanics will use diagnostic equipment employing mini-computers; and telephone operators will rely on computerized directories. But will the use of these new technologies require workers with more sophisticated skills?

To answer this question, it is necessary to examine how technology is applied in the workplace. The application of technology is part of a more fundamental process that has characterized production historically--the process of dividing work tasks into simplified operations that require few skills to perform. Through this process production tasks are fragmented into repetitive and routinized activities for which unskilled and low paid workers can be employed. This movement toward a minute division of labor was first advocated by Adam Smith in The Wealth of Nations and later refined by Charles Babbage:

> Babbage's principle is fundamental to the evolution of the division of labor...it gives expression not to a technical aspect of the division of labor, but to its social aspect. Insofar as the labor process may be dissociated, it may be separated into elements some of which are simpler than others and each of which is simpler than the whole. Translated into

> market terms, this means that the labor power capable of performing the process may be purchased more cheaply as dissociated elements than as a capacity integrated in a single worker. Applied first to the handicrafts and then to the mechanical crafts, Babbage's principle eventually becomes the underlying force governing all forms of work ...no matter in what setting or at what hierarchical level (Braverman 1974, pp. 81-82).

Technology aids this process. The division of work tasks into component parts is often accompanied by the mechanization of some of those tasks. For example, the assembly line adopted by Henry Ford early in this century, although first controlled by nonmechanical methods, was soon mechanized (Gartman 1979, p. 200). As technology advances, an increasing number of work tasks can be mechanized. Advances in micro-electronics, in particular, threaten to further fragment work tasks and contribute to the "deskilling" of jobs (Cooley 1983).

The process of fragmentation not only allows employers to lower their costs, but to better control the production process. The organization of work in the United States has evolved from many small, local units into a much smaller number of large, hierarchical, national and international organizations. This transformation has been accompanied by more sophisticated methods of control (Marglin 1974; Edwards 1979).

Technology also aids efforts to control the workplace:

> Machinery offers to management the opportunity to do by wholly mechanized means that which it had previously attempted to do by organization and disciplinary means. The fact that many machines may be paced and controlled according to centralized decisions, and that these controls may thus be in the hands of management, removed from the site of production to the office--these technical possibilities are of just as great interest to management as the fact that the machine multiplies the productivity of labor (Braverman 1974, p. 195).

In the case of the automotive assembly line, for example, mechanization not only reduced labor costs but allowed management to more easily control the pace of production (Gartman 1979).

It is often asserted that while machines will increasingly perform tasks previously performed by workers, generally the machines will perform the most tedious and least skilled tasks. That is, the most desirable and challenging tasks will continue to be performed by workers. Further, as automation becomes more widespread, with more and more workers using complex, sophisticated machines, workers will need increasingly complex skills to work with them.

James Bright, a professor at the Harvard Business School, investigated similar claims more than 20 years ago. He examined the effects of automation on job skill requirements in a variety of U.S. manufacturing firms. The general assumption, which was as common then as today, was that increasing levels of automation required increasing skills by operators and other production workers (Figure 1). Bright observed, however, that the skill requirements of jobs first increased and then decreased sharply as the degree of mechanization increased:

> ...there was more evidence that automation has reduced the skill requirements of the operating work force, and occasionally of the entire factory force including the maintenance organisation...automated machinery tends to require less operator skill after certain levels of mechanization are achieved. It seems that the average worker will master different jobs more quickly and easily in the use of highly automatic machinery. Many so-called key skilled jobs, currently requiring long experience and training, will be reduced to easily learned, machine-tending jobs (Bright 1958, pp. 86-87).

Evidence for the United States as a whole supports Bright's conclusions: aggregate skill requirements of jobs in the U.S. economy have changed very little over the last two decades despite widespread automation in many industries (Rumberger 1981).

Case studies that have documented the application of more recent technologies in a broad variety of work settings confirm this tendency (Zimbalist 1979a). For example, many of the jobs in the printing industry, such as typesetting, press operating, and photoengraving, historically have required highly complex craft skills (Zimbalist 1979b). A series of technological advances over the last 30 years has enabled many of these operations to be performed by machines. The introduction of teletypesetting machines in the 1950s took over many manual typesetting operations. Then the introduction of computer-aided phototypesetting in the 1960s took over the tasks of word hyphenation and line justification. Finally the introduction of video display terminals removed the tasks of composing from the press floor altogether (Zimbalist 1979b, pp. 107-109). These advances reduced sharply the skill levels of workers who remained in the newspaper composing room.

The computer industry itself, the heart of the high technology revolution, provides another case. Early computers were not only large and expensive by today's standards, but they required programmers and operators with fairly complex skills to use them (Kraft 1977; Greenbaum 1979). But as the technology changed, so did the tasks and the skills involved in their operation. Computer programming was soon divided into the more creative, skilled tasks—performed by computer systems analysts--and the more tedious, routine tasks—performed by computer programers and coders. Programming itself became easier as computer languages evolved from high-level machine languages to packaged programs to more "user-friendly", menu-prompted packages (Kraft 1977).

Advances made in computer software have meant that workers can use computers in a wide variety of work settings without any knowledge of computer languages. The new generation of office computers, for example, are specifically designed so that "no special computer skills are needed to operate" them (Giuliano 1982, p. 149). Moreover, office computers perform many of the tasks formerly done by secretaries, actually reducing the requisite skills of office work (Glenn and Feldberg 1979). Word processors can correct typing errors automatically by use of electronic dictionaries, so letter-perfect typing and strong spelling skills are no longer required. In addition, supervisors can monitor each operator's output and compare productivity among workers instantaneously (Glenn and Feldberg 1979; Arnold, Birke, and Faulkner 1981).

Computers and other products of the micro-electronics revolution are transforming work in virtually all sectors of the economy, from agriculture to transportation to engineering design (Scientific American 1982). The future suggests that this transformation will become even more widespread and that technologies will become increasingly sophisticated. Machines will be able to perform more complex, mental tasks as more advanced software is developed. But the use of such sophisticated equipment will not necessarily require workers with more sophisticated skills. In fact, past technological advances suggest the opposite is often the case. The automobile of today is far more sophisticated than its predecessor of fifty years ago. Yet, today's car is far easier to drive. Computers are far more sophisticated today than they were 10 or 20 years ago. But programming and using computers are considerably less demanding today, and many computer-related jobs require virtually no knowledge of computers.

A related concern is that entire classes of skilled workers will disappear or will be severely reduced in numbers as their jobs are replaced by robots or computer software. For example, robots could replace up to 3 million operative jobs in the next 20 years and potentially eliminate all 8 million operative positions—currently 8 percent of the workforce--by the year 2025 (Ayres and Miller 1982, p. 42). The widespread use of computer-aided design ~~(~~(CAD) may virtually eliminate the occupation of drafter in the not-too-distant future, a potential loss of 300,000 skilled positions (Gunn 1982). The potential of high technology to displace jobs more generally is ominous (Leontief 1982).

It is clear that applications of high technology can be used to enhance the quality of working life and the utilization of worker skills, or to reduce them (Walton 1982). The outcome will depend on how the technologies are applied and how employers use them. Past applications of technology in the workplace as well as present evidence suggest that future technologies will further simplify and routinize work tasks and reduce opportunities for worker individuality and judgement. Moreover, the displacement in jobs and the downgrading of skill requirements for most of the new positions will undermine employment generally, and especially the employment of skilled workers.

Educational Implications

Given the widely, advertised view that high technology will dominate the demand for new workers and raise skill requirements of jobs, the usual prescription is that there must be a vast transformation of the educational system. It is assumed that rising skill levels for employment will require more training in mathematics, computer science, and technical applications for the labor force as a whole as well as an increasing number of workers with specialized training in these fields. Consequently, schools must adapt to these new responsibilities through major upgrading of mathematics and science curricula as well as teacher preparation. Schools also need to establish specialized courses of study in computer applications and programming to provide vocational training for high school and community college students.

We have asserted, however, that while some jobs will require these skills, the vast majority will not. Indeed, one of the major purposes and effects of high technology is to simplify or reduce the skill requirements for performing a particular work task. With the exception of a relatively small number of highly specialized positions for designing and implementing high technology applications, most jobs will not require higher skill levels. Industrial shifts and technological change may require different skills, but the preponderance of persons affected by such shifts will not need more mathematics or computer science. And, for significant numbers of jobs, the skill requirements that will have to be met will be less-demanding.

Based upon these assessments, what educational policies are implied?

First, the general educational requirements for creating good citizens and productive workers are not likely to be altered significantly by high technology. Everyone should acquire strong analytic, expressive, communicative, and computational skills as well as extensive knowledge of political, economic, social, and cultural institutions. These aptitudes and knowledge are required for understanding daily experiences and for ensuring access to social opportunities. To the degree that the present schools fall short of providing these results, they should be sought for their own sake rather than because of the claim that they are required for a high technology future.

Second, since we cannot predict in any precise sense which jobs will be available to particular persons, which jobs they will select from among those available, and what the characteristics of jobs will be over a forty year working life, it is best to provide students with a strong general education and an ability to adapt to a changing work environment. Such adaptation requires a sufficient store of information about culture, language, society and technology as well as the ability to apply that information and acquire new knowledge. Accordingly, general academic and vocational preparation should be stressed, as opposed to specific training, especially for young students.

Specific job skills can best be learned on the job, if a worker's general background is sufficient (Thurow 1975). Recent surveys of both U.S. and British employers indicate that they seek new employees with a sound education and good work habits rather than narrow vocational skills (Maguire and Ashton 1981; Wilms 1983).

Third, if changes in work requirements arise abruptly and change occurs at a faster rate than previously, the educational system may need to respond more quickly and efficiently to training needs. It may require better ties with industry and should not exclude the possibility of more industry-based training activities. It should also be tied to a system of recurrent education, since workers will no longer be able to acquire a set of job skills at the beginning of their careers that will be useful over their entire work lives (Levin and Schutze 1983; Mushkin 1974).

In summary, the educational implications of high technology are that a solid basic education rather than narrow vocational preparation will become more important in the future. This will require elementary and secondary schools to strengthen virtually all their instructional offerings that require analytical and communicative skills.

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Table 1

Employment and Employment Growth in the Fastest Growing Occupations: 1978-90

Occupations	Employment (thousands)		Employment Growth 1978-90		
	1978	1990	Percentage Increase	Number of Jobs (thousands)	Number of Jobs (percent of all occupations)
Fastest relative growth[a]					
1. Data processing machine mechanics	63	156	148	93	0.4
2. Paralegal	28	66	132	38	0.2
3. Computer systems analysts	185	384	108	199	0.9
4. Computer operators	169	317	88	148	0.7
5. Office machine and cash register servicers	49	89	81	40	0.2
Total	494	1012	105	518	2.4
Fastest absolute growth[b]					
1. Janitors and sextons	2585	3257	26	672	3.1
2. Nurses' aides and orderlies	1089	1683	55	594	2.7
3. Sales clerks	2771	3362	21	591	2.7
4. Cashiers	1501	2046	36	545	2.5
5. Waiters/Waitresses	1539	2071	35	532	2.4
Total	9485	12419	31	2934	13.3
Total, all occupations	97610	119590	23	21980	100.0

[a] Based on the percentage increase in the number of jobs created

[b] Based on the number of jobs created

Source: Carey (1981), Table 2

Table 2

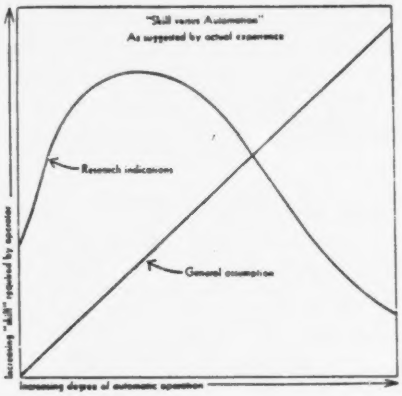
Employment Growth by Major Occupation Group: 1960-90

Major Occupation Group	Employment Growth (percentage distribution) 1960-70 (1)	1970-80 (2)	1978-90 (3)
Professional and technical	30.0	22.3	20.3
Managerial	6.0	22.7	7.7
Sales	5.8	2.6	7.0
Clerical	32.9	21.0	20.0
Crafts	11.2	9.5	12.2
Operatives	7.5	1.8	10.0
Laborers	.7	4.8	4.8
Farm workers	-14.5	- .2	- 2.6
Service	20.4	15.5	20.7
Total	100.0	100.0	100.0

Sources: (1)-(2) Rumberger (1983), Table 2; (3) Carey (1981), Table 2.

Figure 1

The Relationship Between Increasing Levels of Automation and Job Skill Requirements



Source: Bright (1966), p. II-209.

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THE EMPLOYMENT IMPACT OF GOVERNMENT SPENDING

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Abstract

This paper estimates the level and composition of employment generated from government spending in 1980. Expenditures from the federal, state, and local levels of government represented one-third of the Gross National Product in 1980. Government spending generated 16 million jobs in the public sector and another 16 million jobs in the private sector through purchases and transfer programs. Altogether, government spending generated 34 percent of all civilian employment in 1980. Women, minorities, and college graduates have benefited particularly from the growth of government spending. Government expenditures in 1980 generated 60 percent of all professional and managerial jobs held by women and 50 percent of all jobs held by college graduates.

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Unemployment remains one of our country's most pressing economic problems. By the end of 1982, 12 million Americans were out of work or almost 11 percent of the labor force (U.S. President 1983, p. 198). Unemployment has reached the highest levels since the Great Depression. While the current economic recession has contributed to this high level of unemployment, some government economists believe that much of the current unemployment arises from frictional and structural factors (U.S. Congressional Budget Office 1983). Further, recent government projections suggest that unemployment levels will remain high at least over the next five years even with sustained economic growth (U.S. President 1983, p. 144; U.S. Congressional Budget Office 1983a, p. 7). Clearly one of the most pressing economic policy questions concerns how to generate more jobs in the economy.

Many economists and government officials believe that the private sector is the most important arena for generating jobs. Government should primarily aid employment growth indirectly, by stimulating economic growth in the private sector of the economy. To achieve this, President Reagan has cut taxes, which has increased disposable income, reduced government regulations, and cut at least some types of government spending. Although the President has been unable to actually reduce total government spending at the federal level, he has at least attempted to curtail its growth.

While these policies may help to revitalize the private sector of the economy, they ignore the direct role the government plays in creating jobs--in the private as well as the public sectors of the economy. The importance of the public sector as a source of jobs has received considerable attention. The proportion of the labor force employed in the local, state, and federal levels of the public sector grew rapidly between the early 1950s and the mid 1970s--from 13 percent of nonfarm employment in 1950 to over 19 percent of nonfarm employment in 1975. Since 1975 the proportion has declined slightly, reaching 18 percent in 1980 (Tucker 1981, p. 20).

The public sector not only employs a significant portion of the work force, but the type of employment it provides and who it employs differ markedly from the private sector. A higher proportion of the jobs in the public sector are in professional and managerial areas compared to the private sector. Wages also appear to be higher in the public sector, although during the late 1970s this premium eroded as public budgets contained pay increases for government workers (Smith 1977; Rumberger 1983). Public employees enjoy greater fringe benefits and job security as well (Quinn 1979; Long 1982). Finally, the public sector has served as an important source of jobs for women and minorities (Brown and Erie 1981; Rumberger 1983).

In addition to generating public sector employment, government spending creates jobs in the private sector of the economy, both through direct purchases of goods and services and through personal consumption financed by unemployment, social security, and other social programs that provide transfer payments to individuals. This aspect of government-generated employment has received very little attention, although it creates a significant portion of the jobs in the private sector. Government purchases of goods and services alone generated 8 million jobs in the economy in 1980, almost 10 percent of private sector employment (U.S. President 1982, Table G-5). Some industries benefit more than others from government purchases. For example, over 30 percent of employment in the construction industry in 1976 was due to government purchases, particularly by state and local governments (Thurow 1980, Table 4). The differential employment impact of different categories of government purchases have also been investigated. Some analysts claim that defense spending generates fewer jobs than nondefense purchases, while others dispute those claims (Employment Research Associates 1982; U.S. Congressional Budget Office 1983b). But little is known about the types of jobs generated from government purchases or the workers who hold those jobs.

Still less is known about the employment impact of transfer payments. Transfer payments finance personal consumption, but since these payments often go to persons with low-incomes, their impact differs from other personal consumption. Many of these purchases are spent on basic necessities--food, clothing, shelter, and health care. Government social programs, including transfer payments, support a large portion of the service industry, especially in the medical and educational areas (Ginzberg 1976). These industries have provided a large number of jobs for women (Brown and Erie 1981, 1982). But again little is known about the type of jobs generated from government transfer programs.

This paper estimates the employment impact of government spending in the private as well as the public sectors of the economy. The next section documents the level and composition of government spending over the last fifty years and analyzes the impact of government purchases on different industries in the private sector. The following section examines the employment generated by different types of government spending in 1980--the number of jobs, the types of jobs, and the types of workers who hold those jobs. The last section discusses the consequences of shifting government spending from one category to another.

The Growth and Distribution of Government Spending

Over the last 50 years government expenditures have grown tremendously, both in current dollars and as a portion of total economic demand. In 1929, federal, state, and local expenditures amounted to $10 billion or 10 percent of the Gross National Product (Table 1). By 1980 government expenditures exceeded $800 billion, representing one-third of the Gross National Product. Expenditures increased at both the federal and regional levels during this period. Federal spending increased most rapidly in the 1930s because of New Deal programs, while state and local spending increased most rapidly during the 1960s due to the rapid expansion of education and other social services.

Not only has the level of government spending increased over the last fifty years, but its composition has changed as well. During most of this period, roughly 50 percent of the federal budget was used to purchase goods and services, with half of this amount used to compensate government employees and the other half used to purchase goods and services in the private sector (Table 2). By 1980, however, only one-third of the federal budget was used to purchase goods and services. The remainder was used to fund transfer payments to individuals, grants-in-aid to state and local governments, and other activities, including paying off the federal debt. Transfer payments have captured an increasing share of the federal budget since 1960 and now comprise over 40 percent of federal expenditures. Grants to state and local governments also increased over this period.

Almost all state and local expenditures are used to purchase goods and services. Over 50 percent of state and local expenditures were used to compensate government employees in 1980 and another 42 percent were used to purchase goods and services in the private sector. The remainder was used for transfer payments, with other activities (primarily surpluses from government enterprises) contributing a net income. The composition of spending by state and local governments has remained quite similar over the last 50 years.

Government purchases of goods and services in the private sector support a substantial portion of the private economy. Purchases in 1980 by all levels of government exceeded $265 billion (U.S. Bureau of Economic Analysis 1982, Table 3.7B). The pattern of this spending on the industrial sectors of the economy differs markedly from other private spending. The patterns of spending within government also vary by activity and level.

The patterns of private and government spending by industrial sectors can be ascertained from the Input-Output (I-O) tables of the U.S. economy. These tables, which are prepared about every five years by the U.S. Bureau of Economic Analysis, show the sources of final demand for the output of the U.S. economy. These sources are: sales to consumers, sales to business for investment, net sales to foreigners (net exports), and sales to government (Ritz 1979, p. 35). Their sum equals Gross National Product (GNP). The I-O tables also show the gross output of each industry, consisting of sales to other producers as well as final demand, which can be used to show the direct and indirect effects of changes in demand (Ritz 1979, p. 37).

Table 3 shows the patterns of private and government spending on goods and services within major industries of the private sector as well as a selected number of more detailed industries--ordinance, aircraft, business services, and medical, educational, nonprofit services. Government purchases are broken down by federal government, both defense and nondefense, and by state and local government. These patterns are based on the 1972 I-O tables, which are the latest figures currently available (Young and Ritz 1979).[1] In addition, the table shows the impact of transfer payments to individuals, which is actually a component of private spending although it is financed by government. This pattern is ascertained from detailed 1963 I-O tables, although the patterns appear similar to patterns based on less detailed information for 1972 (Stern 1975).

The figures reveal the differential impact of private and government spending. Federal defense and nondefense purchases are much more concentrated in manufacturing industries than either private or state and local government purchases. Federal nondefense and state and local purchases are more concentrated in service industries than other purchases. Transfer payments are concentrated in only a few industries since they are used primarily to purchases basic necessities--food, clothing, shelter, and medical services.

Not only are government purchases concentrated on different industries than private spending generally, some industries depend on government purchases for a significant portion of their product. Defense purchases accounted for 75 percent of total final demand for the ordnance industry in 1972, while 50 percent of total final demand for the aircraft industry originated from government purchases. The construction industry depended heavily on government purchases as well, especially from state and local government. Service industries also benefited from government spending. Overall, 20 percent of all purchases in the private sector of the economy originated from government spending.

Employment Generated by Government Spending

Government spending generates employment in the private and public sectors of the economy. The level and composition of this impact was estimated for the economy in 1980 using spending information from the 1972 I-O tables and employment information calculated from the March 1980 Current Population Survey. Although the distribution of government purchases was based on 1972 I-O data (1963 data for transfer spending), the level of spending within each category was updated to 1980 using data from the National Income and Product Accounts (U.S. Bureau of Economic Analysis 1982, Table 3.7B). Estimates were updated to 1980 rather than using 1972 information in order to capture the increases in government spending (especially for transfer programs) that took place over that period. In other words, the employment impact of government spending increased substantially between 1972 and 1980 because of the growth in government budgets, especially entitlement programs.

This information was used to estimate the types of jobs generated from government spending as well as the amount of employment. Instead of using Census occupation categories to differentiate among jobs, detailed Census occupation codes were grouped into three occupational levels: high, middle, and low.[2] High-level jobs, which cover most professional and managerial occupations, offer the highest salaries and carry the most decisionmaking responsibility; middle-level jobs comprise the majority of jobs in the economy; and low-level jobs represent the least skilled and lowest paid jobs. The estimated level and composition of civilian employment generated from government spending in 1980 is shown in Table 4.

Total civilian employment equaled 96 million in 1980.[3] Of that total, about 16 million persons were employed in the public sector; another 8 million persons in the private sector owed their jobs to government purchases of goods and services;[4] and another 8 million workers in the private sector were employed because of personal consumption financed through government transfer programs. Altogether, more than 32 million jobs--representing 34 percent of all civilian employment in the United States--was generated from government spending in 1980.

The composition of employment generated from government spending differs from the composition of employment in the private sector generally. More than 40 percent of the jobs in the public sector are high-level, professional and managerial jobs, compared to one-quarter of the jobs in the private sector. Government spending in the private sector also creates somewhat more high-level positions than the private sector overall. In contrast, government spending generates a smaller proportion of low-level jobs than private sector spending. Government spending overall generated 42 percent of all professional and managerial jobs in the U.S. economy in 1980, but only 26 percent of all low-level jobs. Not only does the government generate a substantial portion of the jobs in the U.S. economy, it generates an even greater portion of the high-level, professional jobs.

Government spending also generates a large portion of the jobs held by college graduates. One-third of all college graduates were employed in the public sector in 1980 (Table 5). Another 17 percent who were employed in the private sector owed their jobs to government purchases and transfer payments. Altogether government spending generated 50 percent of all jobs held by college graduates in 1980.

The employment generated from government spending benefits some race and sex groups more than others. A greater proportion of women than men are employed in the public sector. Black women especially have benefited from public sector employment--more than one-quarter held government jobs in 1980 compared to 14 percent for white men and 18 percent for black men. Government spending in the private sector employs a similar proportion of all groups. In terms of total employment generated from government spending, black women benefit the most while other race and sex groups benefit more equally.

Among persons holding professional and managerial jobs, race and sex differences in the benefits of government spending are more pronounced. The public sector generated more than one-third of all high-level jobs for women in 1980--over fifty percent for black women. The public sector provides the majority of teaching jobs and many health jobs, which account for a large proportion of professional and managerial employment opportunities for women. The public sector also provides a larger proportion of high-level positions for minority males than for white males. In contrast, government spending in the private sector generates a larger proportion of high-level positions for men than for women.

Similar patterns occur in employment opportunities for college graduates. The public sector provided over 40 percent all jobs held by white and Hispanic female college graduates and almost two-thirds of the jobs for black female college graduates in 1980. Including employment in the private sector, government spending generated over 50 percent of all jobs for female college graduates in 1980 and almost three-quarters of all the jobs for black female college graduates. Black and Hispanic male college graduates also depended more than white males on employment opportunities generated from government spending.

Assessing the Employment Impact of Government Policies

Government spending generates a sizeable portion of all the jobs in the U.S. economy. Some industries and some workers benefit more than others from this impact, however. The construction industry, some manufacturing industries--especially those in defense--and business services benefit from government purchases. Wholesale and retail trade and service industries--especially in medical and educational areas--benefit from individual consumption financed by transfer programs. College graduates, minorities, and women benefit more than other workers from the jobs generated by government spending in the public as well as the private sector.

Government spending arises from a variety of policies and programs enacted at the federal, state, and local level. These activities change over time, shifting the composition as well as the level of government spending. Between 1980 and 1982, for example, government expenditures increased 24 percent and grew from 33 percent of the Gross National Product to over 35 percent (U.S. President 1983, Tables B-1, B-75). Defense spending has captured an increased share of the federal budget, lowering the share for social programs (Waite and Wakefield 1982). How will these changes affect employment?

Table 6 shows the average number of jobs created in the public and private sectors of the economy from each billion dollars of government spending and private spending. The private sector impact is desegregated by major industries and selected detailed industries. Government spending is disaggregated into defense and nondefense categories at the federal level, state and local spending, and transfer payments originating from all levels of government. Although the figures only show the average number of jobs generated by each billion dollars of government and private spending based on 1980 levels, they do suggest the marginal number of jobs created or lost from shifting spending patterns from one category to another.

The estimates reveal that most types of government spending generate more jobs than private spending. In particular, federal nondefense spending and government spending at the state and local level generate about 50,000 civilian jobs per billion dollars while defense spending, transfer programs, and private spending each generate about 30,000 jobs per billion dollars. If military jobs are included in the figures, then the number of jobs generated by defense spending increases to about 46,000. Although the actual figures differ, the general patterns in these estimates are consistent with government estimates using other data and techniques (U.S. Bureau of Labor Statistics 1975; U.S. Congressional Budget Office 1983b, p. 43).

While the number of jobs generated from various types of government spending (excluding transfer payments) are similar, the location of the jobs varies widely. Federal nondefense purchases and state and local purchases generate many more jobs in the public sector than other types of spending. In contrast, private spending and transfer programs, which subsidize private spending, generate more jobs in the private sector.

Different industries in the private sector benefit from the various types of government spending. One billion dollars of federal purchases for either defense or nondefense activities generates from 7,000 to 9,000 jobs in manufacturing, similar to the number of jobs generated from private spending. But those jobs are concentrated in different manufacturing industries. A billion dollars of defense spending generates over 2,000 jobs in the aircraft industry alone. Nondefense spending generates more jobs in service industries. A billion dollars spent on transfer programs generates almost 10,000 jobs in service industries with over 5,000 of those in medical, educational, and nonprofit services. Employment in retail and wholesale trade is almost entirely dependent on transfer and other private spending.

Clearly a shift in spending patterns will affect the number and location of jobs in the economy. An increase in defense spending will create jobs in aircraft, ordnance, and other manufacturing industries while a cut in transfer programs will eliminate jobs in medical, educational, and other service industries. An increase in private spending at the expense of government spending will cause a net reduction in the number of jobs in the economy. For example, a $1 billion reduction in federal nondefense spending coupled with a $1 billion increase in private spending will decrease employment by 20,000.

Shifts in spending patterns will also affect the composition of jobs in the economy and job opportunities for various types of workers. Since public sector employment provides more professional employment opportunities and benefits college graduates, women, and minorities more than other groups of workers (Tables 4 and 5), a reduction in federal nondefense purchases or in state and local purchases will reduce employment opportunities for these groups.

This analysis illustrates the importance of government spending as a source of employment in the economy. Yet rarely is this impact discussed. In only a few instances, such as public service employment programs, do lawmakers consider the employment impact of government spending. But whether they discuss it or not, every policy has a direct impact on the level and composition of employment in the economy.

Although private spending generates the majority of jobs in the U.S. economy, government spending plays an important role as well. At a time when unemployment is so high, lawmakers should consider both the direct and indirect role of government policy in generating employment.

Footnotes

[1] The I-O tables used in these calculations are based on the 85 2-digit industry codes. I-O tables based on 3-digit industry codes are also available, but were not used to save computational expenses. Although the I-O tables are integrated with the National Income and Product Accounts, the figures for final demand may vary slightly between the two systems. For more information, see Young and Ritz (1979), p. 1.

[2] The classification of occupations was based on information from the Dictionary of Occupational Titles on the relative skill levels of jobs. For more detailed information on this procedure, see Rumberger and Carnoy (1980). Although this classification scheme is not the only one that could be used to differentiate among occupations, it is highly correlated with earnings and other measures of labor market standing.

[3] This figure is slightly lower than published figures because: (1) published figures are based on annual averages, which for 1980 was about 2 million more than employment in March, and (2) the present figures exclude about 1 million persons who were working without pay.

[4] The estimated employment impact of government purchases in the private sector correspond with estimates from the U.S. Bureau of Labor Statistics. See U.S. President (1982), Table G-2.

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Table 1

Gross National Product and Government Expenditures,

Selected Years, 1929-80

	1929	1940	1950	1960	1970	1980
Gross National Product ($ billion)	103.4	100.0	286.5	506.5	992.7	2633.1
Government Expenditures ($ billion)[a]	10.3	18.4	61.0	136.4	313.4	871.2
Federal	2.6	10.0	40.8	93.1	204.3	602.1
State and Local	7.8	9.3	22.5	49.8	133.5	357.8
Government Expenditures (% of GNP)[a]	10.0	18.4	21.3	26.9	31.6	33.1
Federal	2.5	10.0	14.2	18.4	20.6	22.9
State and Local	7.5	9.3	7.9	9.8	13.4	13.6

[a] Federal grants-in-aid to State and local governments are reflected in Federal expenditures. Total government expenditures have been adjusted to eliminate this duplication.

Source: U.S. President (1983), Tables B-1 and B-75.

Table 2

Government Expenditures by Type, Selected Years, 1929-80

(Percentage Distribution)

	1929	1940	1950	1960	1970	1980
Federal Government						
Goods and Services	55	61	46	58	47	33
Defense	-	(22)	(34)	(48)	(36)	(22)
Nondefense	-	(39)	(12)	(10)	(11)	(11)
Compensation of Employees	(33)	(35)	(26)	(23)	(22)	(14)
Other	(22)	(26)	(20)	(35)	(25)	(19)
Transfer of Payments to Persons	27	16	27	23	30	41
Grants-in-aid to State and Local Governments	4	9	6	7	12	15
Other (including debt)	14	14	21	12	11	11
TOTAL	100	100	100	100	100	100
State and Local Government						
Goods and Services	95	87	88	93	93	95
Compensation of Employees	(45)	(46)	(45)	(51)	(53)	(53)
Other	(50)	(41)	(43)	(42)	(40)	(42)
Transfer Payment to Persons	3	14	16	11	11	11
Others	2	-1	-4	-4	-4	-6
TOTAL	100	100	100	100	100	100

Sources: U.S. Bureau of Economic Analysis (1981), Tables 3.2, 3.3, 3.7A; (1982), Tables 3.2, 3.3, 3.7B.

Table 3

Private and Government Spending in the Private Sector by Industrial Category, 1972

	Private	Government Spending				
	Spending	Federal		State	Transfer	Total- as a % of
		Defense	Nondefense	Local	Payments	Total Demand[a]
Agriculture	3.5	0.1	-21.1[b]	0.6	3.5	4.0
Mining	1.3	0.0	0.2	0.0	0.0	0.3
Construction	5.8	3.6	14.3	25.3	0.2	29.0
Manufacturing	28.6	53.6	43.8	17.6	18.5	18.3
Ordnance	(.1)	(5.3)	(4.2)	(0.0)	(0.0)	(75.2)
Aircraft	(.5)	(13.8)	(3.0)	(0.0)	(0.0)	(50.2)
Transportation and Utilities	6.5	11.1	6.8	7.2	8.5	25.2
Wholesale and Retail Trade	25.9	3.3	3.8	2.4	31.6	14.9
Finance, Insurance, and Real Estate	7.6	0.1	7.1	5.0	5.5	14.0
Services	20.8	28.3	45.2	41.9	32.3	30.8
Business	(3.5)	(18.0)	(21.9)	(24.3)	(3.6)	(49.2)
Medical, Educational and Nonprofit	(9.9)	(5.3)	(19.2)	(15.7)	(18.7)	(29.8)
TOTAL[c]	100.0	100.0	100.0	100.0	100.0	20.6

[a] Total government spending divided by total demand (GNP).

[b] Negative signs indicate that sales by the government exceeded its purchase from the private sector.

[c] Totals may not add to 100 because of rounding.

Note: Private spending equals total final demand less government spending. Spending by the federal and state and local government covers the purchases of goods and services in the private sector. Transfer payments cover private purchases financed by transfer programs from all levels of government.

Table 4

Employment Generated from Private and Government Spending by Occupational Level, 1980

(numbers in millions of workers)

	Occupational Level			Total	
	High	Middle	Lower	Number	Proportion High Level[a]
Private Sector Employment	20.6	44.4	14.9	79.9	26
Private Spending	16.0	35.1	12.2	63.3	25
Government Spending	4.6	9.3	2.7	16.6	28
Federal	.9	1.9	.4	3.2	28
Defense	(.6)	(1.2)	(.3)	(2.1)	28
Nondefense	(.3)	(.7)	(.1)	(1.1)	27
State and Local	1.4	2.9	.6	4.9	29
Transfer Payments[b]	2.3	4.4	1.7	8.4	27
Public Sector Employment	6.7	7.6	1.6	15.9	42
Total	27.3	51.9	16.5	95.8	29
Proportion of Total Employment Generated from Government Spending	42	33	26	34	

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[a] Employment in high-level jobs divided by total employment.

[b] From all levels of government.

Sources: Calculated from the March 1980 Current Population Survey (U.S. Bureau of the Census); Stern (1975), Table 9; Young and Ritz (1972), Table 1; and U.S. Bureau of Economic Analysis (1982), Tables 3.2, 3.3, and 3.7B.

Table 5

Proportion of Jobs in the Private and Public Sectors Generated by Government Spending,

by Race, Sex, and Type of Job, 1980

	Males			Females			Total
	White	Black	Hispanic	White	Black	Hispanic	
All Jobs	31	35	28	36	45	34	34
Private Sector	(17)	(17)	(17)	(17)	(16)	(16)	(17)
Public Sector	(14)	(18)	(11)	(19)	(29)	(18)	(17)
High-level Jobs	36	46	39	50	68	51	42
Private Sector	(18)	(17)	(17)	(15)	(11)	(14)	(17)
Public Sector	(18)	(29)	(22)	(35)	(57)	(37)	(25)
Jobs Held by College Graduates	44	54	48	59	72	57	50
Private Sector	(19)	(15)	(17)	(15)	(8)	(15)	(17)
Public Sector	(25)	(39)	(31)	(44)	(64)	(42)	(33)

Sources: Calculated from the March 1980 Current Population Survey (U.S. Bureau of the Census); Stern (1975), Table 9; Young and Ritz (1972), Talbe 1; and U.S. Bureau of Economic Analysis (1982), Tables 3.2, 3.3, and 3.7B.

Table 6

Jobs Generated Per $1 Billion of Government and Private Spending, by Industrial Category, 1980

	Government Spending				
	Defense[a]	Nondefense	State & Local	Transfer	Private Spending
Private Sector	16,300	16,100	14,700	29,600	29,900
Agricultural	0	-3,400[b]	100	1,000	1,000
Mining	0	-1,000[b]	0	0	400
Construction	600	2,300	3,700	0	1,700
Manufacturing	8,700	7,000	2,600	5,500	8,505
Ordnance	900	700	0	0	0
Aircraft	2,200	500	0	0	200
Transportation and Utilities	1,800	1,000	1,000	2,400	1,800
Wholesale and Retail Trade	500	600	400	9,300	7,700
Finance, Insurance and Real Estate	0	1,100	700	1,600	2,300
Services	4,600	7.300	6,200	9,600	6,200
Business	2,900	3,500	3,600	1,000	1,000
Medical, Educational, and Nonprofit	900	3,100	2,300	5,500	3,000
Public Sector	13,700	35,000	35,000	-	-
Total	30,000	51,100	49,700	29,500	29,800

[a] Each $1 billion of defense spending also generates 15,900 military jobs.

[b] Negative signs indicate that sales by the government exceeded its purchases from the private sector.

Note: Numbers are rounded to nearest 100.

Sources: Calculated from the March 1980 Current Population Survey (U.S. Bureau of the Census); Stern (1975), Table 9; Young and Ritz (1972), Table 1; and U.S. Bureau of Economic Analysis (1982), Tables 3.2, 3.3, and 3.7B.

Mr. **Walgren**. Thank you very much, Dr. Rumberger.

Well, that is a wide-ranging plate of issues for the public to deal with and for us to try to discuss. I wanted to go back initially to Mrs. Freedman and give you an opportunity to expand just a little bit on the subjects that you just touched on at the end. Particularly the service employment technology and some of the themes that have been developed by the others will fit into some comments you might have on the impact of technology on service employment.

Ms. **Freedman**. About a quarter of our work force is now involved in manufacturing and other goods-producing employment; this may fall as low as 10 percent by the end of the century. The rest of total employment will be in service-producing functions. It might be better to call this the production of intangible goods, because services include such industries as public utilities, communications, transportation, retailing, finance, health care, government, protective services, and education. Not all of these services are labor-intensive, and many of these industries are undergoing a great deal of technological change, becoming increasingly automated if you want to use the word.

However, service employment in the human-serving kind of activity will surely increase and these industries cannot be fully automated. We talked a moment ago about a society in which increasing numbers of people are living alone. A society really in which we are not dependent upon each other. We do not function in family units to care for each other. A great deal of that activity that was charity and intrafamily caring kind of work is now done on the market for pay. Yes, the society in which probably lower wages will prevail; and in which a lot more women will be employed in doing the things that might have been done 100 years ago within the family and within the community for nothing.

The human-serving and caring kind of things that we call—as industries—health care, protective services, education, food. It is interesting that the Bureau of Labor Statistics call the industry "food away from home"—the fastest growing industry right now, "food away from home." So this kind of service employment will engage most of our work force by the end of the century, the manufacturing and goods-producing work having been taken over by machinery and flexible manufacturing systems.

Mr. **Walgren**. I see.

Let me go on and ask you to touch on the Japanese investment in the United States. You indicated that it is seen as a positive thing by those receiving it but only with respect to high-technology employment. Why is the focus on the high technology?

Ms. **Freedman**. I think because it is fashionable now, first of all. Second, I think that people are frankly saying maybe the Japanese will come here with some of their flexibility, some of their fast learning, some of their development of technology that might have been discovered here but not applied here. There are many new technologies that were American-invented but never American-adopted that have been adopted by the Japanese. So in a way perhaps people are expecting it to be brought back home and perhaps disseminated to American businessmen. This is a tremendous motivator right now for American business leaders. We have got to get sharp, we have got to get efficient, we have got to do better than the Japanese. We have to compete with the Japanese. It is motivating industrial executives who 10 years ago were somewhat lethargic about developing their human resources and their technical resources.

Mr. **Walgren**. Let me ask the panel as a whole, do you see the population becoming a widening gap, as Dr. Hill mentioned, between the rich and the poor and a smaller amount of wealthier people and a larger segment of people who really are held down by the labor market to relatively low wages and denied the upward mobility that we have associated with the high labor rates that were able to be commanded by basic industries? Would you make a 30-year prediction of whether that is going to be the direction that this society is going in?

Dr. **Rumberger**. It is not necessarily so, but I think that is definitely a possibility. You have to look at what kind of jobs are likely to appear in the future, what the pay is associated with those jobs, and whether there are going to be enough jobs. To the extent that an increasing number of people are going to be locked into lower level jobs, then I think there could be increasingly disparity in the distribution of income.

We now relate or tie income to work. It has always been that way. So people's income is related to how much they work and what they work at, and if it is true that we may not have enough jobs or that there is going to be these kind of disparities, then we may have to do something directly with income policy. Maybe income in the future should not be related to work, or related to work in a different way than it is right now.

Mr. **Walgren**. Would the underemployment that you see in college graduates now be a harbinger of the fact that there is not the skill levels of work available in this society for those people who are qualified for it to attract more than minimum wages? If, by and large, we have a society made up of people working at the minimum wage with no way for them to rise above that, then would it not follow that the masses, the large numbers of people in America will become poor, and those who happen to command ability to own the wealth, produced by the machines, will become increasingly more wealthy?

Dr. **Rumberger**. That is highly possible, yes. I think in general the competition for the best jobs is going to increase. It is already very severe among college graduates, it is very tough to compete for the best jobs, and that competition I think will only increase as the number of people with more education increase.

Mr. **Walgren**. Dr. Hill.

Dr. **Hill**. I guess I would have to concur with Dr. Rumberger. I do think that the likelihood of a widening economic gap is very strong. Our U.S. class stratification has been one place where you had more of a bulge in the middle. If you really look increasingly with respect to our income tax structure now, which it is getting less and less progressive, you are finding now that bulge has become more thinner, so that you have the bulge more at the bottom and smaller at the apex. I think that in terms of the number of jobs, unless there is some specific action taken, there is really more of an incentive to have more capital-intensive industries. There is a real likelihood that you will have a much smaller growth rate of new jobs and greater degree of overeducation in that people with high educational levels will be performing tasks for which such education was not typically required.

Mr. **WALGREN**. Mrs. Freedman, would you like to comment on that?

Ms. **FREEDMAN**. I have to say, I see the greatest damage in defining people away from being supporting and contributing members of the economy. By the turn of the century, we will have people beginning to approach the age that we now consider the age of retirement, or early retirement—there will be a "boom" of people in their late fifties and early sixties.

If we have defined these ages as retirement periods, when perhaps half the population will be moving into those ages, we are creating some social class problems that are even more severe. A resentment on the part of working age groups at the number of dependents that they have to support. The "loafers"; those who for various reasons we have socially defined out of the work force or defined out of being supporting members of the society. We will have created so much early retirement that less than half a lifetime will be involved in being productive. That is a social problem that would be terrible, terrible.

Mr. **WALGREN**. Thank you.

Mr. Bateman.

Mr. **BATEMAN**. Thank you, Mr. Chairman.

May I say that a fine panelist may have not done a great deal to make mine a happier day.

Let me offer a comment and at the risk of it appearing to be a very sexist male chauvinistic kind of point of view ask for some reactions.

You have noted the increased incidence of women in the work force, and I am very much aware of that phenomenon, and let me say I am not concerned about that as a phenomenon if you isolate only that factor.

If you look at that and look at other statistics, in terms of measurement of social problems, incidence of divorce, the deterioration as many would see it in the family structure, how well the social fabric seems to hold together, is there a relationship between that phenomenon of increased women in the work force, that relates to what ultimately becomes, the number of singleperson households? Have any of you focused on whether there is a relationship? I suspect it is largely an academic concern of mine because I certainly do not propose to try and do anything legislatively to prevent it. Yet one has to wonder whether or not as you see the statistics on the one side and the incidence of increased negative social statistics on the other hand, indicating a relationship? And where should society try to go within the context of remaining a free society?

Dr. **HILL**. I would like to respond. I am aware of a number of studies that have examined the correlation between the labor force participation of women and family instability and all the other ills that you mentioned. First of all, these studies indicate that a major reason that women went into the labor force was because of greater economic insecurity in their family—more specifically, increasing double-digit inflation. There was a surge in the number of working women in the seventies when you had increasing economic insecurity. Thus, there was a greater need to have two earners in the household. Historically middle-class blacks have always had two people working.

At the present time we have a higher proportion of two earners among whites than blacks. But during the seventies when we had the greatest degree of family instability, we also had inflation and recessions occurring stimultaneously. Economists had told us it was impossible to have inflation at the same time as a recession. Our economy in the 1970's did not listen, we had both. The conseequence of this economic instability was a very high degree of family instability. So that I think studies have shown that the higher incidence of family instability is more a result of the economy than of women going into the labor force. Thus, the latter is a spurious relationship.

Mr. **Bateman**. You do not see it as something that is a matter of preference or choice but something that is driven by an economic necessity of a family which then may produce certain adverse social conditions.

Given if we had a magic wand, and could have a stable and prosperous noninflationary economy, would you anticipate that the trend in terms of incidence of women working outside of the home would continue to rise, or would it remain stationary, or would you anticipate it would decline?

Dr. **Hill**. Well, what was the assumption about the nature of the economy?

Mr. **Bateman**. It was going to be a stable level of prosperity, unattended by significant inflation.

Dr. **Hill**. I do not know. However, at the same time we talk about the economic revolution, we must acknowledge that the sexual revolution provides women with more work options. I think that you would still have a higher level of women in the labor force even if we return to some level of economic prosperity.

Dr. **Rumberger**. I think that is right, part of it is that women have felt compelled to work for economic reasons and part of it is that women have wanted to work for other reasons. So to the extent that the latter is an important factor, then having a more stable economy like you suggested would not necessarily lower the participation rate.

Mr. **Bateman**. Perhaps on a somewhat less broad dimension, if you look from the point of view as a historian in an analysis of the work force and the implications of increased technology, historically, am I wrong in thinking that increased technology, notwithstanding immediate dislocations in the workplace, translates into larger number of jobs rather than a lesser number of jobs?

Dr. **Rumberger**. That was the concern raised in the fifties and early sixties in a wave of automation that prompted the creation of Presidential Commission on Technology, Automation, and Economic Progress. In fact, I was reading the report last night. It is not necessarily true that automation or technology which is always going to occur in some industries and displace some workers, will necessarily raise the aggregate level of unemployment. It really depends on what happens to the economy overall, which depends on many other factors, such as oil prices and the world market situation. So if, for whatever reasons, the U.S. economy can sustain long-term growth, then having this technological displacement may not be very serious. That was the conclusion reached by the Commission 20 years ago.

But, can the United States sustain long-term economy growth at the levels that we had in the sixties? The Commission was formed when unemployment was relatively high, at 5 percent. Then unemployment went down to 4 and they decided that technological unemployment was not so serious. It turned out that the sixties was a time of very prosperous long-term economic growth in the United States. Now we have an unemployment rate of over 10 percent. And the situation may be different today. I think part of the reason it may be different is that the kinds of technologies that we see are more widely applied or will be more widely applied. And the rate of technological change I think is perhaps greater than it was before, and the fact that microelectronics, which is the basis really for a lot of these technologies, now will impact almost every kind of job. I think it is possible that technological displacement will be more serious than it was in the past.

Mr. **Bateman**. I assume that is sort of a byproduct of the fact that the increase in technology is almost all-prevasive in all aspects.

Dr. **Rumberger**. Sure, computers are the best example. We can apply and use computers in almost any kind of job. One of the references I had in one of the papers I brought was the Scientific American issue from last fall 1982, which was very interesting because it describes many of the different types of jobs in industries where technology is being applied. The computer, as a basis for a lot of these, has no bounds really. It can really be used everywhere.

Mr. **Bateman**. It is always a bit of a mystery as to what extent if at all we in legislative bodies can in fact affect social policy or the social condition. I am one of those who thinks that we perhaps unduly flatter ourselves as to how much we can indeed do. But if you take the problem of unemployment, and especially the larger incidence of unemployment among young people, do we work at cross-purposes when legislative bodies begin legislating that employers cannot mandatorily require retirement of workers at a given age? Is that perhaps an incidence where legislative policy is working at cross-purposes with a perceived social need or condition?

Ms. **Freedman**. You are referring to the possibility that employers might retire workers and hire younger workers to replace them? I was addressing that very problem, the problem of pushing people out of the labor force or offering them retirement options too soon—too soon for me in any case, when I think of what is going to happen to the dependency ratio as a result by the end of the century. Right now we are going into a period in which there will be a dearth of teenagers; and, developing within 15 or 20 years, a surplus of on-the-verge-of-retirement people. You do not want to create public policy that enlarges that retirement group and makes it a tremendous burden on the very few left in the work force by the time you are done rearranging policy. That is why I place particular emphasis on the withdrawal from the labor force of middle-aged men who have lost their last job, been pushed out probably, but cannot find another for lots of reasons. Age discrimination is one of them, another one is the employer sees no reason to invest in somebody who might only give 5 or 10 years of work. The attraction of nonwork income is another one.

Whatever it is, you have a work life which might be from say age 25 to age 55, much less than half of a full lifetime, and the rest is dependency. By the turn of the century that dependency will be a tremendous burden on the existing work force and a social problem that will cause resentment: "Why are we supporting so many of those people who are living from the age of 55 to 83 on our backs?" This is very dangerous. So, the short-term solution: wonderful, we will retire people earlier and hire young people, and that will solve it, we will adapt to automation by offering early retirement. From a company's point of view that is a very good and humane and generous way to ease out and to ease down their work force, and in fact during the recession, this was also done to ease back on the work force. But for the society, in the long run, it creates a social problem.

Mr. **Bateman**. How much is that social problem perhaps exacerbated by the type of social security system that we have developed and maintained in the financing premises of it, the structuring of it, rather than some alternative types of financing arrangements? Certainly our problem would become incredibly astute. We have gone through a great deal of trauma, for instance, with the social security system, because of the large number of people receiving benefits in relationship to the number of people still working and paying benefits.

I guess to ask a question of you, off the top of your head, to something that complex is perhaps unfair, but, have we not maybe done an entirely inappropriate job of structuring a very beneficial, a very critically necessary thing like social security, around the financing premises and formulas that we have utilized?

Anyone want to tackle this spontaneously.

Dr. **Rumberger**. Whether or not unemployment is viewed as a problem depends, in part, on how income is distributed in a society. There is also a concern about work itself: how many jobs are there going to be and how many people are there who want to work at a job? Personally I think that everybody who wants to work should be able to work. That decision will always be influenced by an income policy; that is, what the wages are in the jobs and what each person's option is regarding retirement. So, I cannot answer your question directly. Employment policy and work policy always really has to be tied to issues of income policy. Conceivably right now everybody could work if we structured work correctly, or everybody could have an income above the poverty level if we wanted to distribute income in that way. So it is a question of how we distribute whatever wealth our economy generates, and to what extent is the distribution related to how much people work and even when they work.

Mr. **Bateman**. Thank you. If I may, one final question because that brings me to the note that I made. Dr. Rumberger, you made reference to historically, presumably to the present time by and large, our income policy has been those workers most in demand with the higher level of skills and productivity were more generously compensated. That strikes me as being a very rational kind of a policy. Certainly if you take it on the individual-by-individual basis that seems most fair. I take it, though, that if you define a social problem that you see alternative income policies that you believe might be more workable. Could you give me some of those alternatives to what presently serves as an income policy?

Dr. **Rumberger**. Well, just an example, without going into any detail, would be a tax policy that was less regressive than it is now and negative income tax which has been discussed. Taxes redistribute incomes, so we can change our tax structure and then change the distribution of income as a result. So there are lots of ways that that could come about. I do not really, cannot venture at this point more specifically how that would come about.

Mr. **Bateman**. Those things, though, obviously a State inheritance tax affect the distribution of wealth. But in terms of earnings, earning of income policy, how progressive or regressive an income tax are they? I hear you as saying that there is no other manageable——

Dr. **Rumberger**. We tie income to work, you mean?

Mr. **Bateman**. Once it is earned, you can do something with how much of it you tax depending upon how much of it you have and that sort of thing, but what happens in the workplace with the employer versus employee relationship.

Dr. **Rumberger**. But there are alternatives in terms of job creation and what kind of jobs are created. A lot of investment tends to be in areas of high-capital expenditures and therefore low-job creation. There are alternative kinds of policies and types of industries that we can promote. Some types of investment create more jobs than others. The Government does not have an explicit policy that addresses this issue.

Government, for example, contrary to a lot of prevailing views in Washington at the moment, is a very sizable and important employer. Some estimates I did recently on both direct employment of government and indirect employment generated through purchases in the private sector and transfer payments show that government generated 50 percent of all the jobs held by college graduates in 1980. Whatever policies are enacted have an employment impact, and they have a differential impact depending on the kind of policies.

Mr. **Walgren**. Could we go back over that figure? Could you give me that again?

Dr. **Rumberger**. Government spending in the United States, based on 1980 estimates, accounted for about one-third of our GNP. It also generated about one-third of all our jobs in the economy if you count the jobs created directly in government, the jobs created in the private sector through the purchases made by government, defense being probably the best example of that, and the employment generated through transfer payments to individuals who in turn spend that money on goods and services in the private sector. All those aspects of government spending, which is more than 90 percent of total government expenditures, together generate about a third of our employment in this economy. But more interesting are the types of jobs that government generates. Based on these same estimates, government generates about 40 percent of all professional/managerial, high-level jobs in our economy, and generates 50 percent of all the jobs held by college graduates.

Mr. BATEMAN. Could I follow up on that for a moment?

Mr. WALGREN. Sure.

Mr. BATEMAN. Let us assume that the Federal government, at least that aspect of the governmental apparatus, spent a great deal more, and therefore left a great deal more in resources with the citizenry for them to respond to, to investigate. Do you think there are some tradeoffs there that equal number of jobs that might have been created?

Dr. RUMBERGER. Sure. The point is only that all spending has an employment impact. Government spending has an employment impact, but it is generally never considered explicitly in most legislation. Legislation arises from policy concerns. But all legislation generates spending and spending generates employment. That employment has impact both on the number and types of jobs available in the economy, and I should point out, it has impact on who is employed. The public sector employs many more women than men in high-level jobs; more than 50 percent of all the high-level jobs held by women are in the public sector. Two-thirds of all high-level jobs held black women are generated by government spending, partly because a lot of black women in professional jobs are in teaching and other educational areas, which are generally government supported. So it has impact on level of employment, types of employment, and who is employed.

Mr. WALGREN. Let me recognize at this point Mr. Dymally for further discussion.

Mr. DYMALLY. Thank you very much.

Dr. Hill, I want to deal with some statistical problems which I think have some relevance to this. Sometime at the end of this month, the Department of Labor, Bureau of Statistics will say that unemployment in the country is 10 percent; you will say as you did when you were with the Urban League, yes, but among black youth in Philadelphia, it is *x* percent, and in Los Angeles and Cleveland. Explain to me this difference, why do the Urban League researchers come up with different figures about minority and specifically black youth employment as compared to the labor statistics numbers?

Dr. HILL. Well, first, let us be clear about how the Labor Department defines unemployment when it has the Census Bureau interviewers ask persons in 60,000 households each month about their work experience during the preceding month. If individuals indicate that they were not working last month, but were searching for work, they would be considered to be unemployed. However, if individuals not working indicate that they were not looking for work last month--but had been during the 5 prior months, they would not be classified as officially unemployed, but as discouraged—particularly, if they gave as a reason for not looking for work that "they think they cannot find a job."

Many economic analysts think that the group of discouraged workers that Mrs. Freedman referred to are very similar to the official unemployed. In fact, I am currently engaged in research related to deriving a more appropriate classification of discouraged workers. Moreover, women, minorities and youth are overconcentrated among discouraged workers. This is why the unemployment rates double when discouraged workers are added to the officially unemployed as I did with the National Urban League's Hidden Unemployment Index. Furthermore, the President's National Commission on Employment and Unemployment Statistics—headed by Dr. Sar Levitan—felt so strongly about this issue that it recommended that the Labor Department give serious consideration to the inclusion of discouraged workers in the official jobless count. Although the Labor Department still leaves them out, it does publish separately alternative measures of unemployment rates that include discouraged workers.

I think it is important to emphasize, however, that there is nothing underhanded about the actions of the Labor Department concerning this dispute about discouraged workers. It only reflects the caution of the Bureau of Labor Statistics about the implications of such changes for the broad array of labor force statistics, past as well as future, based on many years of outstanding professional experience. Moreover, it does not calculate or array jobless figures differently for minorities. It is just that, since minorities are overrepresented among the discouraged workers, the inclusion of discouraged workers in the unemployment count makes a bigger difference for them than among non-minorities.

Mr. DYMALLY. Thank you.

Ms. Freedman, you made reference to the Immigration and Naturalization bill before the Congress changing the way we hire people in the future. You also said there is an estimate of 3 to 6 million undocumented workers in the country. There is speculation they may be taking jobs.

What kind of jobs are they taking, and given the fact that it is said that most of the new jobs are in the low-level service areas, what implication does that have for the increase in the pool of jobs and people, limited amount of jobs, increasing amount of people?

Ms. FREEDMAN. These immigrants are here to work. They are not just evenly distributed across the age spectrum either. They are young, generally young men in their 20's to 30's who have come here specifically for a job. If we knew precisely how many, we could say we don't have 99 million people employed; we have 106 million employed. That was the first point.

You are probably right in thinking that a large number of illegal immigrants are working in services—in jobs that can be off the books, in small establishments where off-the-books employment is more possible than for large employers—and service kinds of operations where there is a lot of flow in and out, a great deal of labor fluidity.

I don't know that is exclusively the case, however. There are some large companies that have placed assembly facilities fairly near to the border with Mexico, for example, that are very happy to get immigrants, legal or illegal. Companies consider them very fine workers, highly motivated. Subject as they are to deportation, illegal immigrants are more tractable than other workers.

One of the things that is creating the market is the possibility of employing off-the-books workers at lower labor cost levels. No social security tax, no unemployment insurance tax, no worker's compensation insurance, no benefit costs, and no minimum wage. If we eliminated the statutory minimum wage, there might not be as much employment of illegal immigrants. In other words, there might be more jobs for Americans at, yes, below the minimum wage and, yes, dishwashing in restaurants—the kind of work that now may be done at $2.50 an hour or $2.00 an hour by illegal immigrants. We have a minimum wage which prohibits employment of persons below $3.85 an hour.

Mr. **DYMALLY**. Thank you very much.

Dr. Rumberger, you represent an important area dealing with computer technology and recently one of the large manufacturers of computers decided to pull up and leave for a foreign country. Given that fact, what do you project for the future, 2000, in terms of unemployment, and do you see this as a trend of moving East instead of going West young man?

Dr. **RUMBERGER**. I see it as a trend. But it is actually a trend that has been going on for some time. In part, it is really a part of a larger trend which is simply that manufacturing employment in the United States is decreasing and has been decreasing for a number of years, so in a way it is just a further example of the trend toward decreasing employment in manufacturing.

What is most disturbing about it are the kinds of jobs that are being eliminated as a result of this movement. Previously a lot of technology in high-tech areas, computer design and manufacture, was really sophisticated and uncertain so that manufacturing in these areas was done in the United States. But what we are finding out is that even the manufacture of very sophisticated technology, chip design and things like that, can now be done in a semiautomated fashion with a fairly low-skilled work force. Therefore, these operations can now be shipped overseas.

So I see this trend continuing. The claim made by these companies is that unless they do that, they will not remain competitive on the international market; they will lose out to the Japanese or whoever is building similar products. If they do capture an increasing share of the market or market gross, they can increase sales. Then, they say, they will create more employment in the United States in the kind of jobs that are left here.

The problem really, though, is how much growth are they going to have to experience for them to generate jobs, and if an increasing number are located overseas, the amount of growth needed to create each new job is going to have to get larger and larger. I don't see that is an important source of employment growth in the economy as a whole because of the long-term trend of decreasing employment in manufacturing.

Mr. **DYMALLY**. Thank you.

Dr. Hill, the Urban League was born as a result of the migration of Southern blacks to the North. We are experiencing, one, a shift of industry to the so-called Sunbelt and a recent shift of migration. Do we see in the future the headquarters of the Urban League in Atlanta? What do you see as the future trend of shift of industry and minorities back to the South?

Dr. **HILL**. First of all, the movement of the industries to the South is also movement toward less unionized areas of the country. Again, we are talking about lower labor cost.

I found it very interesting that since over half of the black population is still in the South, one would think that they would benefit from this movement of jobs to the South. However, I found, after looking very closely, that the plants were not moving closely to those blacks in the South. So the unemployment rates for southern blacks did not go down as a result of the movement.

Moreover, I do think that the shift in population to the South and the West, is also responsible for the shifts of industries. I think that it is interesting that the Sunbelt is not as rosy as we thought it might be. There is higher unemployment there, such as in Houston and other places, and the oil glut has had a negative impact there.

What we are witnessing is that many of the negative economic impacts are being felt nationwide. I see the U.S. industrial center going overseas which is very frightening.

Mr. **Dymally**. For several years now American manufacturers have considered adopting Japanese styles of management, and you made reference to that in your study, the Government is toying with the idea of setting up Japanese-like relations among industry and Government and academia.

If we look at literature about Japan, what we read is that Japan's success has crested, and is beginning to experience some of the same problems the rest of the industrialized world has been experiencing. If we were to start imitating the Japanese, we would be imitating a model in the end as vulnerable as the one we now pursue, Mrs. Freedman?

Ms. **Freedman**. I am not sure I would say that we can "imitate" the Japanese either in the ways they use to increase their economy's productivity, or in its decline.

We had that conference on Japanese management of American work forces to say some things to American managers that could have been said about good practice originating right here. But when we dress it up in a kimono, it sold better; it was more acceptable.

We were saying things like this: You should be telling your employees a great deal more about the business' performance in order to involve employees in the enterprise. Tell workers how they are functioning, what labor costs are, what production rates are, what is happening in the market, how sales are doing, et cetera, et cetera. In other words, business performance information that is now considered proprietary, you would never tell the employees; we were advocating that employees be told so they would be involved in the enterprise.

This is something that is done in Japanese firms and is done especially in Japanese firms operating here. The additional motivation, though, of telling American managers this is what the Japanese are doing and this is part of their reason for success has a wonderful concentrating effect because American managers are willing to learn from the Japanese.

I would not advocate that we copy something just because it is Japanese. However, we might learn some things that the Japanese are doing that we ought to have been doing ourselves.

Mr. **Dymally**. One final question of Dr. Rumberger. In your part, Dr. Levin and you do a great deal of work in the field of education also. Would you like to comment on the need to have computer literacy on the one hand, but the inferior quality of resources in the urban schools on the other hand. How do we bridge that gap?

Dr. **RUMBERGER**. I think there is a need for students to acquire what Levin and I would call technological literacy as opposed to computer literacy. We are concerned that many people, educators in particular, are rushing onto the computer bandwagon, wanting to have a computer in every classroom and making sure that everybody has some exposure to the computer.

We feel there is some peril, just as there was in past head-long rushes, into applying any kind of new technological development in the classroom. We see a need for computers or some exposure to computers, but in a broader sense than I would say a lot of people see it. That is, we don't think every student should know how to program a computer because most people are never going to program in their jobs. They may use a computer in their jobs, but will not need to program it.

Our idea is for every student to have exposure to technological innovations, the computer being one, and having some familiarity with it. We would caution urban schools in particular, who have restrained budgets, about spending too much money or putting too much attention on the computer because they are hurting for resources in other areas. We generally feel that the best education for the future is a general basic education because much of future is unknown.

We do know that people change jobs a lot now, and we anticipate in the future people will change jobs even more. So there is going to be a lot of mobility. In addition, there are going to be a lot of new jobs that we don't know about right now. So there is a lot of uncertainty in the future.

We do believe that the pace of change will probably accelerate, so the uncertainties will multiply. How do you prepare workers for jobs that we don't know exist at the moment? You give them the skills and the basic education to learn new specific skills when those jobs arise.

I don't want to downplay the importance of the computer in the classroom, but I think it may be somewhat overemphasized, especially if it is done so to the expense of good basic education and to the expense of resources devoted to a good basic education.

Mr. **DYMALLY**. Thank you, Mr. Chairman.

Mr. **WALGREN**. Who on earth thought of calling the discouraged workers not unemployed in the first place? How far back does that go?

Ms. **FREEDMAN**. The interview that forms the questionnaire to a family asks "Are you working, and is this member of the family working, is that member of the family working?" If the answer is no, then the question is "Did you look for work in the past 4 weeks?" If the answer to that is no, then the question is "Why didn't you look for work?" And if the answer is "I didn't think there was a job available," that is a discouraged worker.

The person is not in the labor force because in fact it is better to think of the unemployed as looking. Instead of using the word "unemployed," there were 11 million people looking for work last month. In addition, 1.7 million people in the first quarter were not looking because they didn't think they could find a job.

Then there are other people who say "I didn't look because I am in school" or "I didn't look because I am staying home taking care of the children," or "I didn't look because I am in poor health." Those people are not in the labor force; and they are not discouraged workers, either. Does this help at all?

Mr. **Walgren**. Well, I think it probably explains what is going on, but I just couldn't let it pass without underscoring how misused I think that concept is by the news media and by perhaps all administrations, depending on how long it has been going on.

It seems it would be much more honest to say there are the unemployed and really unemployed. It may be academically interesting for us and maybe even social policy to know there are discouraged workers, but when you turn on the evening news, you attribute one general meaning to being unemployed, and it includes discouraged workers in spades. It just troubles me deeply that we have these systems that sort of distort the meaning of the words, and I just can't let that go by without registering an objection to it, not your use of that at all, but the evening news and Government use of that concept because it is not honest.

Ms. **Freedman**. That is part of what I mentioned earlier: This is a labor force very responsive to incentives and disincentives, and these people are saying "there are so many disincentives piled up that I am not going to make the investment required to look for work." Looking for work costs money, it takes time as well. You have to get up, get car fare and bus fare and go out and look and spend days and so forth, and it is psychologically expensive too.

"This is an investment," they are saying, "that is not going to return anything; I know the returns will be zero, so I won't make the investment."

Mr. **Walgren**. Well, I guess really it would be interesting to look at discouraged workers. I think you would find a lot more discouraged workers out there now than there were discouraged workers 4 years ago. That is a very sliding judgment of the effort, the investment, the sacrifice on their part, in that you have to weigh the prospects of success; and if the prospects of success are minimal, there is going to be a lot more discouraged workers and in many ways. I suppose you have unemployment and employment, and this unemployment is a lot worse than other unemployment or other types of unemployment, at least in the people that individually present themselves to Members of Congress. There are few Members of Congress willing to help anybody find a job these days, and it is really because there aren't any and they know it.

Well, I don't mean to get off on that subject, but it is, I think, worth noting that eliminating those discouraged workers from the unemployment, from the concept of unemployment, is really reaching for it by our statistical system at this point, and I object.

Well, other things?

Dr. **Hill**. I could share with the committee a paper that I prepared for the National Commission on Employment and Unemployment Statistics in which I assessed critically the Government's procedures for classifying discouraged workers. The basic fallacy is that the Labor Department assumes that the reasons people give for not looking for work can be used as the basis for inferring they are unavailable for work. There was a distortion in terms of the concept.

Mr. **Bateman**. I would like very much to have a copy of that. Could I?

Mr. **Walgren**. We ought to enter a certain amount of it in the record.

[The material provided by Dr. Hill follows:]

Submitted by Dr. Robert Hill

Bureau of Social Science

The Measurement, Behavior, and Classification of Discouraged Workers

T. Aldrich Finegan

June 1978

National Commission on Employment and Unemployment Statistics
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Introduction

Finegan's analysis of discouraged workers effectively sets forth some of the key issues related to the propriety and feasibility of including this group in the official labor force. It clearly describes the procedures used by the Bureau of Labor Statistics to classify this subgroup and summarizes their most salient demographic characteristics. In order to determine the extent to which changes in the number of discouraged workers are affected by changes in the economy, Finegan computes regression estimates of changes in various subcategories of discouraged workers based on a 1 percent change in the nation's unemployment rate. He also examines the extent to which changes in the number of discouraged workers correlate with changes in the number of officially unemployed workers at different economic cycles between 1968 and 1977. His paper makes several insightful recommendations regarding possible new criteria to be used in classifying discouraged workers and additional information needed to enhance our knowledge about them. His most important recommendation, however, is that discouraged workers, as currently defined, be excluded from the official labor force because too little is known about this group.

While Finegan's recommendations regarding the exclusion of discouraged workers from the official labor force appropriately follow from the confines of his analysis, his analysis was just that--too confining. It was restricted almost entirely to that subgroup of persons currently classified as "discouraged" workers by the U.S. Department of Labor. It failed to even consider the more central policy issue: whether the official definition of unemployment inappropriately excludes larger numbers of "hidden unemployed" persons who want work and are available for it, but are not actively seeking work because of discouragement. This failure to explore the possibility of attaining a broader and more valid classification of discouraged workers was responsible for several major flaws in Finegan's analysis.

The first and perhaps most important shortcoming in Finegan's approach was its tacit acceptance of the popular misconception that the reasons that people give for not actively seeking work can be used to infer their unavailability for work. For example, if a woman indicates that she "wants a regular job now," but is not actively seeking it because of child care responsibilities, it is arbitrarily assumed that she is unavailable for work because of household responsibilities. Such an assumption is highly unwarranted and unjustified as this critique will attempt to demonstrate. Acceptance of this conventional wisdom led Finegan to concentrate most of his study on the reasons why persons were not looking for work rather than specifically probing their availability for work.

A second deficiency in Finegan's analysis was its failure to challenge the official coding procedures that tend to understate the number of discouraged workers by giving priority to reasons reflecting personal responsibilities (such as child care, school attendance, etc.) rather than to discouragement reasons for not seeking work. If anything, his assessment suggested that BLS coding practices probably overstated the number of discouraged workers.

A third weakness was the lack of any comparison of the official discouraged workers with the larger group of persons who also indicated that they wanted a job, but were not actively seeking it. If certain segments of this larger group resembled the official discouraged, it was possible that a case might be made for broadening the definition of "discouraged" workers as well as for incorporating this broader group into the official labor force.

A fourth shortcoming was its failure to compare the larger group of workers who want a job, but were not looking for it, with the official unemployed. Such comparisons might reveal that certain categories of this larger group closely resembled the official unemployed (with regard to past work history or attachment to the labor force, for example), which might strengthen the case for including such subgroups with the official unemployed.

A fifth deficiency, which grows out of the others, was the omission from its recommendations of any research to explore the feasibility of broadening the definition of discouraged workers or to consider whether other subgroups of workers who indicated they wanted work, but were not actively seeking it, might be included in the official labor force. We will now examine each of these shortcomings at greater length.

Inferring Work Unavailability

The availability of discouraged workers for work is one of the most crucial issues for determining whether they should be included in the official labor force. In order to be classified as unemployed, under the official definition, a person must be (1) without a job and (2) actively looking for work and (3) available for work. Since discouraged workers are clearly jobless and, by definition, are not actively seeking work, it is their availability for work that becomes a pivotal factor for determining their inclusion with the official unemployed.

It should be understood, however, that BLS does includes some people who are not actively seeking work with the official unemployed: (a) persons waiting to start a new job within 30 days and (b) workers waiting to be recalled from layoffs. Thus, not actively seeking work does not automatically exclude one from the official labor force.

In order to determine the work orientation of persons not in the labor force, special questions are asked of one-fourth of the Current Population Survey sample and are published quarterly:

1. When did ___________ last work for pay at a regular job or business, either full-time or part-time?
2. Why did ___________ leave that job?
3. Does ___________ want a regular job now, either full-time or part-time?
4. (If "Yes" or "Maybe":) What are the reasons ___________ is not looking for work?
5. Does ___________ intend to look for work of any kind in the next 12 months?

Discouraged workers are classified by BLS according to the reasons given for not looking for work. Persons who "want a regular job now," but say they are not looking for work because of home responsibilities, school attendance, ill health or disability, are not defined as "discouraged." Only the subgroup who "think they cannot get a job" are officially defined as discouraged. More specifically, one must give one or more of the five following reasons--and none of the other reasons (such as family responsibilities, school attendance, etc.)--to be considered "discouraged": (a) Believes no work available in line of work or area; (b) Could not find any work; (c) Lacks necessary schooling, training, skills or experience; (d) Employers think person is too young or too old; and (e) Other personal handicaps (such as discrimination, criminal record, or less than honorable military discharge) in finding a job.

Usually, about one-tenth of all persons outside the labor force say they "want a regular job now." But only one of every five such persons give reasons that fit the official criteria for discouraged workers. In other words, over 80 percent of all people wanting work, but not looking for it, are excluded from the discouraged worker category as well as from the official unemployed. What are the reasons for the exclusion of this larger group of people who want work? Undoubtedly, as Furstenberg and Thrall indicate, they are excluded because of unwarranted assumptions about their unavailability for work based primarily on their reasons for not looking:

> By the narrow definition applied by the Labor Department, these individuals also do not satisfy the operational requirement for being unemployed; that is, they are not actively job seeking. However, like those classified as discouraged workers, they have indicated that they desire employment.... Presumably, the decision not to record these individuals as unemployed is based on the assumption that if they are either too unmotivated or too socially constricted to look for a job, they are not actually in a position to take a job and hence are quite properly excluded from the labor force. This assumption is based on a misinterpretation of facts and a misunderstanding of the social and cultural processes which underlie labor force participation.
>
> Simply because they have not been actively looking for a job, there is no reason to conclude that these 4.5 million individuals (including the discouraged workers who are part of the same category) would not be able to accept employment if a job were offered. Each of these persons has declared that he or she wants a regular job now. The reasons they give for not looking for work are not necessarily reasons for their not being able to work if a job were available. For example, if a

> woman explains that she has not been job hunting because of child care responsibilities, she may merely be reporting why she has been unable to look for work....
>
> If the CPS were to ask those individuals who indicate that they want regular employment whether they are currently available for work, it would probably discover, as the authors did, that a large proportion could make the necessary arrangements to take a job if one were available. 2

In fact, based on their analysis of the Parnes national longitudinal data on women between the ages of 30 and 44, Furstenberg and Thrall found not only that a sizable proportion of the women outside the labor force reported that they were available for a job if offered, but also that their labor force status two years later corresponded more closely to that of the official unemployed than to those who had reported (two years earlier) that they were not available for work. In contrast to the standard CPS questions, the Parnes survey specifically inquired about the work availability of women not in the official labor force through the following question, "If you were offered a job by some employer in this area, do you think you would take it?" About one-third of the women interviewed in 1967 said that they would definitely or probably accept a job if one were offered to them.

A follow-up interview of these women in 1969 revealed that about one-third of the women who said that they were definitely available for work in 1967 were actually working two years later as were about one-fourth of the women who said they were available with qualifications. At the same time, about half of the officially unemployed women who were looking for work in 1967 were also working by 1969. On the other hand, only 15 percent of the women who reported that they were not available for work in 1967 were working two years later. Thus, women who said they were available for work but were not looking were twice as likely to be in the labor force two years later as those who said they were not available for work. Consequently, as Furstenberg and Thrall concluded, the available women more closely resembled the official unemployed than they did the unavailable women:

> Given this evidence for a continuum of attachment to employment, it is unreasonable and misleading to draw a rigid line between active job seekers and the availables and to say that the line marks the boundary of the labor force. These data

> appear to support our assertion that when individuals say they are interested in working, even if they are not actively looking for a job, the likelihood is that they really do want to work and will respond to an opportunity for employment. While they are not as likely to become jobholders as are the unemployed, they resemble them more nearly than they do those who say they are not available for work; this is particularly true when we confine our comparison to women who said without qualification that they were available for work. When we look separately at subgroups which have high rates of employment, the resemblance between the unemployed and the availables becomes even stronger. For example, childless women and those with college degrees who said they were available for work were employed two years later in higher proportions than were those who actively sought work in 1967. 3

Thus, reports of availabilty for work (particularly those that are unqualified) appear to be more reliable predictors of future employment for certain groups not in the labor force than are reports of active job seeking of persons in the official labor force. Clearly, these findings cast serious doubt on the widespread belief that "looking for work" should be the preeminent criterion for classifying most persons as officially unemployed. More importantly, they suggest that the lack of any question in the standard CPS interview schedule specifically inquiring about the availability for work of the official unemployed as well as of the "hidden unemployed" seriously compromises the validity of the current definition of unemployment. In short, it is just as unwarranted to infer the availability for work of persons solely on reports of their alleged job seeking activities as it is to infer the unavailability of persons solely on reports of their reasons for not seeking work.

Understating Discouraged Workers

Not only do BLS classification procedures understate the actual unemployed population who want work and are available for it, but they unjustifiably restrict the number of discouraged workers as well. According to the CPS Interviewers Reference Manual, only those persons wanting a job who reported one or more of the five reasons for not looking for work that fall into the "think they cannot get a job" category are classified as discouraged workers. If such persons also give one or more other reasons (such as home responsibilities, school attendance, ill health, etc.) for not seeking work, those reasons are assigned greater weight than their discouragement reasons resulting in their exclusion from the official discouraged worker category. In short, the discouraged worker category is restricted to only those persons giving one of the five "think they cannot get a job" reasons and no others! Although Finegan took note of this BLS coding procedure, he failed to question its effect on understating the number of discouraged workers.

This official coding practice violates several important canons of survey research related to the probing of reasons for people's behavior. First of all, it fails to adequately take account of multiple responses that cut across both dimensions by arbitrarily assigning greater weight to nondiscouragement reasons which in fact may be less significant impediments to looking for work than discouragement factors. At no time does the CPS questionnaire ask the respondent to indicate which of their multiple reasons (i.e., discouragement or nondiscouragement factors) are of greater importance for their not looking for work. Instead, this judgment is made by BLS analysts on the false premise that personal responsibilities intrinsically outweigh discouragement reasons for not seeking work.

Secondly, this coding procedure sets up a rigid dichotomy between discouragement and nondiscouragement reasons that does not properly allow for intrinsic or overlapping relationships between the two dimensions. For example, persons not looking for work might report that they are in school or have assumed certain home responsibilities because they "couldn't find any work." According to the official coding system, such persons would not be classified as discouraged workers since they had school or home responsibilities--despite the fact that these responsibilities were assumed because of discouragement (i.e., they could not find any work). Any report of personal responsibilities automatically disqualifies one from being a discouraged worker, regardless of how overriding discouragement reasons were as factors in their not looking for work. The boundary between discouragement and nondiscouragement reasons is not nearly as rigid as the official coding practices assume.

Third, these procedures violate fundamental methodological considerations that should be incorporated into any analyses of reasons. According to the late Columbia University sociologist, Paul Lazarsfeld, who was the foremost exponent of "reason analysis" in this nation, any survey research that attempts to determine the reasons for people's behavior should always take account of self-reports and rankings as well as of independent assessments with regard to key dimensions for analysis.[4]

Since BLS has concluded, after years of careful research, that the dimensions of discouragement and nondiscouragement reasons for not seeking work are the two most essential for classifying discouraged workers, then the significance of each of these dimensions should be determined on the basis of both self-reports and independent analysis. For example, if respondents report only nondiscouragement (or only discouragement) factors as reasons for not looking for work, the interviewer should be instructed to specifically probe: (1) whether any discouragement (or nondiscouragement) reasons may have also been factors and (2) the relative significance of discouragement to nondiscouragement reasons.

BLS analysts might contend, however, that they have resisted probing for discouragement (or nondiscouragement) reasons for persons giving only nondiscouragement (or only discouragement) reasons, because they do not want to "lead" the respondent. But this is a misunderstanding of the basic requirements for conducting an adequate "reason analysis." It is essential that all respondents have the same opportunity to indicate the significance of each of these two dimensions as possible reasons for their not looking for work. In most surveys, respondents predictably fail to mention some of the most important reasons for their actions if they are simply asked in a completely unstructured fashion. By specifically probing for the significance of both discouragement and nondiscouragement reasons, all respondents are provided with the same framework for their responses.

Fourth, the current one-sided coding procedures for identifying discouraged workers are part of broader classification patterns by BLS that place unwarranted reliance on independent assessments over self-assessments. Reason analysis techniques permit investigators to often give greater consideration to their independnet judgments over those of respondents. But such disregard of self-reports and self-assessments is justified only after comparative research has clearly demonstrated that the investigator's assessments of the behavior of respondents are more valid than self-reports or self-rankings. Yet not only have such com= parative analyses apparently not been conducted to show the greater validity of independent assessments over self-assessments regarding the issue of discouragement, but respondents are often never even asked to assess their own behavior.

For example, respondents indicating that both discouragement and nondiscouragement reasons were responsible for their not seeking work are never asked to assess which reasons were more important than others; BLS does it for them by arbitrarily deciding that personal responsibilities always take precedence over discouragement reasons, thereby minimizing the number classified as discouraged workers. Similarly, despite the fact that they say they want work now, those respondents giving personal responsibility reasons (or even discouragement reasons, for that matter) for not seeking work are never directly asked whether those responsibilities would make them unavailable for work if offered; instead, their availability for work is arbitrarily assumed, thus excluding them from both the discouraged worker category as well as from the official unemployed. For that matter, BLS never specifically asks even the official unemployed whether they would be available for work if offered. It arbitrarily assumes their availability on the basis of reports about their looking for work.

And, finally, BLS never directly asks any nonworking persons whether they are in fact unemployed. That classification is made by BLS analysts on the basis of self-reports of job-seeking activities and other independent criteria. While the weight of past research would probably justify BLS reliance on independent classifications of the unemployed over self-classifications, its rationale for not seeking direct self-assessments about the availability for work of all those wanting work and the relative importance of personal responsibilities to discouragement reasons for not seeking work is much less tenable--especially when it has the effect of understating the actual number of persons available for work.

Omitted Comparative Analyses

While Finegan conducted several useful analyses comparing economic patterns of subcategories of official discouraged workers with the official unemployed, he failed to undertake similar analyses comparing the broader group (over 80 percent) of persons wanting work now with either the discouraged workers or the unemployed. These omissions were unfortunate because, as Furstenberg and Thrall also found, such additional comparisons could have strengthened the case for broadening discouraged workers as well as for incorporating the broader group with the official unemployed.

Finegan suggested that the recent work experience of discouraged workers is an important criterion for determining their probability of reentering the labor force in the near future. His analysis found that 30 percent of the official discouraged workers in 1977 last worked less than one year ago. But Finegan failed to present similar data for the larger group of persons wanting work now.

For purposes of this critique, the most recent comparable data available to us were from the special Census Employment Survey (CES) of poverty areas across the nation conducted by the Census Bureau for BLS between 1970 and 1971. Our analysis of the CES data revealed that 31 percent of all persons not in the labor force wanting work now (i.e., including the official discouraged workers) had worked less than 12 months ago. These findings strongly suggest that persons wanting work who are excluded from the official classification of discouraged are just as likely to have worked in the recent past as official discouraged workers. Apparently, persons giving personal responsibilities (child care, school attendance, etc.) as reasons for not seeking work are just as likely to have worked recently as those persons giving discouragement reasons.[5]

Finegan also indicated that the future work intention of discouraged workers would be an even stronger predictor of their probability of reentering the labor force. Accordingly, his data revealed that 78 percent of the discouraged workers in 1977 said they intended to seek work within the next 12 months. But, once again, he did not present data on the work intentions of the larger group of persons wanting work now.

According to data from the 1970-71 Census Employment Survey (CES) of low-income areas, not only did over half (53 percent) of all persons wanting work (including the official discouraged workers) plan to look for work within 12 months, but about two-fifths of the persons in the CES survey who planned to look for work within the year had in fact worked less than 12 months agao.

These findings provide further confirmation for Furstenberg and Thrall's contention that attachment to the labor force should be viewed as a continuum and not as a rigid boundary between subgroups of those wanting work (i.e., between official and unofficial discouraged workers) and between those outside the labor force who want and are available for it and the official unemployed. Since these results indicate that the official discouraged workers and the broader group of persons wanting work are somewhat similar in their recent work experience and future work intention, it would have been more informative had Finegan provided comparable data for each of the major subcategories of those wanting work.

For example, how different in fact are the recent work experiences and future work intentions of persons wanting work who were not looking for it because of home responsibilities, school attendance, ill health and discouragement reasons? Such comparison would facilitate distinguishing those subgroups that are more likely to be available for work and should possibly be combined with the official unemployed.

Another type of comparison that would have strengthened the case for incorporating certain groups outside the labor force with the official unemployed would have been the presentation of data showing the extent to which persons in the official labor force also have personal responsibilities. For example, about half of all working mothers with children 3-6 years old are able to care for their children themselves as are one-third of those mothers holding full-time jobs. Similarly, three-fifths of young persons 16-21 years actively seeking work have school as their main activity as do one-fifth of young persons 16-21 who are employed. Clearly, personal responsibilities have not prevented them from also being in the labor force.[6]

Additional Recommendations

We strongly concur with Finegan's excellent recommendations regarding additional kinds of data that are needed to enhance our knowledge of discouraged workers. But we would extend the collection of such data to the larger group of persons wanting work who are currently excluded from the official discouraged worker category. Furthermore, we would offer the following additional recommendations:

1. That the Commission strongly urge the U.S. Labor Department to both conduct and commission a wide range of studies exploring the feasibility of: (a) including in the official labor force subgroups of "hidden unemployed" workers wanting work but not seeking it (in

addition to the official discouraged worker), and (b) of broadening the definition of discouraged workers by testing a variety of questions that directly assess their availability for work and their reasons for not seeking work. Preferably, a social scientist who has made use of reason analysis techniques should be commissioned to conduct at least one of these studies.

2. That the Labor Department should conduct special studies testing a variety of questions that directly inquire about the availabilty of work of the official unemployed as well as of those persons not in the labor force who want work but are not seeking it.

We, like Finegan, feel that additional studies (such as those cited above) need to be undertaken before one can confidently recommend that a specific category of "hidden unemployed" be included in the official labor force. Nevertheless, we strongly urge the Commission to assign one of its highest priorities to such a vital research endeavor.

FOOTNOTES

1. U.S. Bureau of Labor Statistics, "How the Government Measures Unemployment" (1973), Report 418.

2. Frank F. Furstenberg, Jr. and Charles A. Thrall, "Counting the Jobless: The Impact of Job Rationing on the Measurement of Unemployment," Annals, AAPSS, Vol. 418 (March 1975), pp. 45-59.

3. Ibid.

4. Elihu Katz and Paul F. Lazarsfeld, Personal Influence (Glencoe: Free Press, 1955).

5. U.S. Bureau of the Census, 1970 Census of Population: Employment Profiles of Selected Low-Income Areas, U.S. Summary - Urban Areas, Report PHC(3)-1, Washington, D.C., 1972.

6. U.S. Bureau of Labor Statistics, Special Labor Force Report: Employment and Unemployment Trends During 1977, No. 212, Washington, D.C., 1978; U.S. Bureau of the Census, Current Population Reports: Daytime Care of Children: October 1974 and February 1975, Series P-20, No. 298, Washington, D.C., October 1976.

Mr. **Bateman**. I think it would be very helpful to have. I think what we are addressing is that over a period of time, and I don't know who and I am not applauding or condemning whoever it was, we have accumulated a system by which we make statistical data available regarding the nature of the work force in the United States. It would seem to me that it perhaps is not very artfully done, but I guess what we end up with is that we have a system in here and now the word unemployment becomes a word of art, it is really not how many people are unemployed; it is how many under a certain type of measurement the Bureau of Labor Statistics say are unemployed, and that becomes a word of art.

Maybe we need a much better public perception of what is happening in the work force and the degree of social, economic, and personal human problems that are represented by what is happening in the work force.

Ms. **Freedman**. Congressman Bateman, I don't want the Bureau of Labor Statistics to come away with a very bad feeling on your part. They do produce another unemployment figure, another unemployment rate; they produce in fact seven other unemployment rates based on different concepts. The highest, in the first quarter of 1983, was 15 percent.

This rate included the discouraged workers; as well as full-time job seekers, one-half of the part-time job seekers, one-half of the total on part-time work schedules for economic reasons—that is, people who have had their work hours cut back. That was 15 percent in the first quarter.

Mr. **Walgren**. Nationwide, 15 percent?

Ms. **Freedman**. That is right, in the first quarter of 1983.

Dr. **Rumberger**. I might add that another source of understatement in terms of unemployment is the fact some people who are working either part time or full time receive wages that keep their families below the poverty level. A report recently issued by the U.S. Commission on Civil Rights includes that as another source of unemployment or underemployment. It just reflects the fact that people may be working, but they are not earning enough to keep their families above the poverty level.

So there are many factors, I think, not just discouraged workers and part-time workers, that have been addressed by different groups that indicate the official unemployment rate very much understates the proportion of people who want to work or want to work at better jobs and want to work at jobs where they can receive enough money to live above poverty.

Mr. **Walgren**. Well, I certainly wish commentators on the evening news would pursue those figures. I know they recognize the concept, but I never thought that nationwide unemployment hit 15-percent. I think I knew it was there, but I am thinking back of the information that we make our political judgments based on, and I don't recall a 15 percent number in the last 2 years.

Mr. **Bateman**. Mr. Chairman, this is by no means a light subject; it is a very, very heavy subject. If the unemployment figure in the United States is 5 percent or 20 percent, we in the Congress, to the extent that there are things we can do about it, ought to be doing those things.

I am not sure that the sheer quantifying of something in terms of a figure is totally critical to dealing with the public policy of it. Five percent unemployment is more than should be permitted if there are legitimate things that Government can do to respond to the 5-percent unemployment.

One of the things that, I guess maybe in terms of a measurement of the problem, we probably need to know more about, on the other side of the equation, is at any given point in time how much of unemployment is an inevitable feeling of people who are in the process of changing jobs in a mobile work force, who are very likely perhaps in a category where they will most surely find employment, but they have just chosen to stop one job because they want to go into another job.

There are all kinds of things I suspect we might be asking the Bureau of Labor Statistics to tell us that they did not do on the microfront, only on the macrofront.

I guess my real point is to understand the statistics as to whether it is 5 percent or 20 percent who want work and cannot find it, it is helpful to know, useful to know, better to know it than obscure it. I am not sure it tells us what we can do about it.

Mr. WALGREN. Thank you very much on behalf of the committee.

Our second panel consists of Ms. Patricia Hogue, staff director, National Commission for Employment Policy, and Duke Ramsey, president, Pittsburgh Alliance for Employment of the Handicapped.

Let me welcome you on behalf of the committee.

At the outset I want to welcome Mr. Ramsey, who comes from my part of the country, and who has made wonderful contributions to our community in a most important area.

Let me ask you to just proceed with your statements for 10 minutes or thereabouts informally. Your written statements will be made part of the record.

Please proceed to outline or communicate however you feel you would like to make your points.

Ms. Hogue.

[The biographical sketch of Ms. Hogue follows:]

PATRICIA W. HOGUE

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1980 - 1982	Director of Legislative Affairs, NCEP
1976 - 1971	Legislative Assistant to Congressman William A. Steiger (R-Wis.)
1968 - 1971	Legislative Assistant to Congressman Steiger
1967 - 1968	Personal Assistant to Congressman Steiger
1967	Assistant to the Vice President for Legislative Affairs, So. California Edison Company
1965 - 1967	Assistant to the Director of Public Relations, Republican National Committee
1964 - 1965	Assistant to the Director of Evening College Admissions, Old Dominion University, Norfolk, Va.
1963 - 1964	Assistant to the Director, Arts and Sciences Division, Republican National Committee

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1959 - 1963	University of Massachusetts, B.A., Political Science

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1978 - 1980	Member and past Chair, CETA Advisory Council, Alexandria, Va.
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STATEMENTS OF PATRICIA W. HOGUE, STAFF DIRECTOR, NATIONAL COMMISSION FOR EMPLOYMENT POLICY; AND LUCIEN P. (DUKE) RAMSEY, PRESIDENT, PITTSBURGH ALLIANCE FOR EMPLOYMENT OF THE HANDICAPPED

Ms. HOGUE. Thank you, Mr. Chairman.

I must say I have to commend you and your colleagues for your willingness to try to absorb so much information in one morning. I think as I listened to the other panel that the incredible number of statistics and facts and projections is just somewhat overwhelming, even sitting in the audience. So to try to have to make some sense out of it is quite a challenge.

As with the other panelists, I have been asked to talk about the demographic changes occurring in our Nation's work force, and to specifically address the changes facing particular groups such as Hispanics, older workers, women and blacks and how these changes will affect future labor markets.

You really cannot pick up the newspaper or turn on a television set today without seeing something about the changes taking place in the American work force. It was with this in mind that our commission entitled its recently-released eighth annual report, which I hope you received a copy of, "The Work Revolution."

We attempted to pull together what is known about the anticipated changes and suggest some of their implications for public policies and programs.

As I say, I think you may find, as I do when I hear or read about the changes going on, that there seem to be a number of conflicting scenarios before us, a confusing array of information and projections. Some say we are going to need a much more highly-trained work force.

We heard Dr. Rumberger say that on the Bureau of Labor Statistics list of 20 fastest growing occupations, the top 5 are going to be janitors, waiters and waitresses, sales clerks, cashiers, and nurse's aides, occupations which we don't traditionally think of as requiring a great amount of skills. So when we have to look to the future, we have to think of the demand for skills and what kind of skills are going to be needed, and we have to look at the supply of labor that is going to be availble.

There is of course a lot more certainly on the supply side of the equation, because everybody who would be in the work force in the next 15 years or so has already been born, so we can look at those numbers and make some fairly decent projections.

I think our biggest unknowns in that area are going to be how many people are going to choose to be in the labor force of the future, and then how many immigrants, especially illegal immigrants, are going to enter our work force.

Well, you have heard from some of the witnesses on some of the changes we expect. But let me just review a little bit some of those trends.

First, while the growth of the U.S. population is slowing considerably, the labor force is going to continue to grow, but at a pace less than in the decade of the 1970's. By the end of the 1980's, approximately 125 million people will be in the work force.

That is a net growth of about 20 million people from 1980 compared to a net growth of 24 million over the decade of the 1970's.

What this means is that the economy is going to have to create about 25 million new jobs over the decade if we are going to bring unemployment back down to 6 percent. Some people don't think 6 percent is a remarkably low level, considering what it was in the 1960's.

Well, if you look at the chart on page 3 of my testimony, I think it becomes immediately apparent, as Audrey Freedman pointed out, among the trends business and Government leaders must consider in fashioning effective employment policies are going to be a maturing work force and proportionately more women, blacks and Hispanic workers.

As Ms. Freedman pointed out, there is no uncertainty about the increased participation of women in the workplace. Women have accounted for about 60 percent of the net growth of the labor force since World War II, and the trend is expected to continue through the decade, even though the projected rate of increase will slow.

This increase in labor force participation has occurred among all groups of women—white, black, and Hispanic.

Historically, women who work have been concentrated in relatively small numbers of occupations. These are, typically, female occupations such as clerks and typists and service workers which offer relatively low pay and few opportunities for advancement.

As new occupations develop or others expand in response to technological change, women may find broader career opportunities than in the past. But this outcome is really dependent upon their acquisition of the skills necessary for high-paying jobs, as well as the elimination of discriminatory barriers that act to exclude females from upper level and other well-paid positions.

Of special concern is the fact that again, as Audrey Freedman pointed out, 9 out of 10 of the single heads of households in the United States are women, and one of every three of these female-headed households is living in poverty, despite the fact that 60 percent of them are in the labor force.

A woman who has a child while still a teenager is especially at risk of being poor.

Dr. Hill was talking about the growth in the black population. In 1979, the black proportion of the civilian labor force 16 and over was 12.3 million. The Bureau of Labor Statistics middle growth projections indicate that the black labor force will be 16.5 million in 1990. It is a relatively young population. While the overall youth population is declining, as Dr. Hill pointed out, the black youth population will increase by about 1 percent in the decade.

The economic and employment situation for educated blacks, especially those with postgraduate education, has improved somewhat and the black-white income gap has narrowed, but for the great majority their relative status seems to be about the same.

Well, what are the reasons for the economic and employment problems of blacks?

I think the answer is complex. Racism and discrimination are still with us and must be counted I think as important factors. But there are other factors that also must be taken into account, some of them of which the panel before ours alluded to.

Major changes certainly have been taking place in the economy that have affected employment opportunities for blacks, beginning with the post-World War II decline in agricultural employment. In many ways increased technology and automation are just the latest in a series of such changes.

In September 1982 our commission published a report called "Hispanics and Job, Barriers to Progress."

Hispanics are a growing part of the population. Hispanics now constitute 6 percent of the working age population and by 1990 it is projected that they will comprise at least 8 percent of the persons of working age. Hispanics, like blacks, are also a growing population. Half are under age 24, and almost one-third are under age 15.

I think it is important to understand that Hispanics are a diverse population. On the mainland United States, Mexican-Americans make up about 60 percent of the Hispanic population; Puerto Ricans, 18 percent; Central and South Americans, 8 percent; Cuban Americans 6 percent.

The entire Hispanic population is also concentrated in certain parts of the country. Two-thirds live in California, New York, Texas, and Florida.

Now, as a group, Hispanics experience high unemployment rates relative to whites, yearly incomes above blacks, but below whites, low hourly earnings, and their high school dropout rates are higher than those for either blacks or whites.

They are also more likely to be in blue collar jobs than are whites or blacks.

When we look at the employment problems among different groups of Hispanics, we find that there are problems that are specific to each group, and that is very important when you are considering policy decisions that affect the Hispanic population.

Research shows while several of the groups experience different labor market problems, the causes are basically the same: Lack of proficiency in English, low levels of formal schooling, and discrimination in the labor market. And of these, lack of proficiency in English is the most severe problem that Hispanics face in the labor market.

Let me just take a minute and talk about youth in general.

The youth population will continue to decline from a peak of 37 million in 1980 to around 24 million in 1990. Although the total number of youth will decline in this decade, as I mentioned, two groups of youth, Hispanics and blacks, will increase by about one percent.

The labor force share of 16- to 24-year-olds is projected to drop from 24 percent to 18 percent in 1990.

Now, I think even though unemployment rates are very high among youth, almost three times that of adults, it is important to remember that by the time most youth reach their middle twenties, they have successfully made transitions from school to work. What the Commission did is identify four groups of youth that have persistent employment problems. They have employment problems when they are young, and those problems persist into adulthood. And those groups are: Young women, minorities, high school dropouts, and youth from low-income families.

For women the major problem really is they are occupationally segregated and receive lower wages. But for Hispanics, blacks, and high school dropouts, discrimination, unstable jobs and reduced access to career ladders are additional barriers to their success.

Recently there has been a great increase in the interest in improving education which the Commission certainly applauds. It is not only in the area of remedial programs for youth, but also the concern about general education for all young people as measured by competency, and the fact that competency has not really kept pace with the rise in educational attainment as measured by years of schooling. Youth stay in school longer, but they don't achieve more. That is a real concern.

When we look at these facts you can see that even favorable demographics won't prevent high rates of youth unemployment if the youth and available jobs are not well matched.

Mr. Chairman, at this point I could summarize a bit more, if you have the time. I don't want to impose upon Mr. Ramsey's time, but if you would like me to take a couple of more minutes, I could do that.

[The prepared statement and supplementary material provided by Ms. Hogue follow:]

Testimony of

PATRICIA W. HOGUE
Director
NATIONAL COMMISSION FOR EMPLOYMENT POLICY

Mr. Chairman, I am pleased to appear before this joint hearing on technology and employment to provide testimony on behalf of the National Commission for Employment Policy. The legislation which recently reauthorized the Commission, the Job Training Partnership Act (P.L. 97-300), specifically directs us to provide advice and information to the Congress and the Administration on employment and training issues. Certainly the hearings you are holding this month focus on important and timely issues: the relationship between advancing technology and changes in the nation's work force and work environment, and government's role in easing the adjustment to change.

I have been asked to address the demographic changes occurring in our nation's work force, and specifically to address the changes facing particular groups, such as Hispanics, older workers, women, and blacks, and how these changes will affect future labor markets.

I was particularly pleased to be asked to testify on these issues because the National Commission has just released its Eighth Annual Report, which puts the issue of demographic change in the context of what we expect those changes will mean for a changing labor market. You can't pick up a newspaper or magazine or turn on TV without seeing something about the changes taking place in the American work force and workplace. It was with this in mind that the Commission entitled its Eighth Annual Report: The Work Revolution and attempted to pull together what is known about these anticipated changes and suggest some of their implications for public policies and programs. The report has been distributed widely, to all Members of Congress and most of the committees, to relevant Federal agencies, and to hundreds of private individuals and agencies involved in employment and training matters. Much of my testimony today will be drawn from that report and from a brief policy paper recently adopted by the Commissioners. That paper calls for a reassessment of our government policies, specifically through partnership arrangements among government and the private sector (including both business and labor) to establish a new priority for employment policy in the development of overall economic policies.

You may find, as I do when I hear or read about the changes going on, that there seems to be a number of conflicting scenarios before us--a confusing array of information and projections. Some say we will need a more highly trained work force in order to remain competitive, others say technology will actually reduce the skill levels needed by the average American worker. Some say we face a high tech future, others point to the Bureau of Labor Statistics (BLS) list of the 20 occupations in which there will be the most net new jobs over the decade and note that janitors, waiters and waitresses, sales clerks, cashiers, and nurses' aides will be those sectors where most of the new jobs will be found.

There is, of course, more certainty on the supply side of the equation. Everyone who might be in the work force over the next 15 years has already been born--our biggest unknowns in this area are how many people will choose to be in the labor force (and we have some fairly reliable projections from the Bureau of Labor Statistics on this) and how many immigrants, especially illegal immigrants, will enter our labor force (a much more difficult statistic to project).

I. CHANGES IN THE WORK FORCE

While the growth of the U.S. population is slowing considerably, the labor force will continue to grow but at a pace less than in the decade of the 1970's. By the end of the 1980's, approximately 125 million people will be in the work force. That is a net growth of about 20 million people from 1980, compared to a net growth of 24 million over the decade of the 70's. This means the economy will have to create some 25 million jobs if unemployment is to be brought back down to 6 percent by the end of the decade.

What will the work force look like in 1990? Some rough projections suggest the following:

in 1990	compared with	in 1980
45-47 percent women		42 percent women
13-14 percent black		12 percent black
8-9 percent Hispanic		6 percent Hispanic
18 percent youth (age 16 to 24 years)		24 percent youth
12 percent older workers (age 55+)		14 percent older
70 percent prime age (age 25 to 54)		62 percent prime age

Therefore, among the trends that business and government leaders must consider in fashioning effective employment policies are a decline in labor force growth, a maturing work force, and proportionately more women, black, and Hispanic workers.

Women

There is no uncertainty about the increased participation of women in the workplace. Women have accounted for about 60 percent of the net growth of the labor force since World War II. This represents one of the most revolutionary employment changes of the postwar period. Moreover, the trend is expected to continue through the decade, even though the projected rate of increase will slow.

This increase in labor force participation has occurred among all groups of women--white, black and Hispanic. For 1982, 56 percent of adult black women, 53 percent of adult white women, and 50 percent of adult Hispanic women were either working or looking for work. BLS projections indicate that, by the end of the decade, about 60 percent of both black and white women will be in the work force.

Historically, women who work have been concentrated in a relatively small number of occupations. These "typically female" occupations--such as clerks, typists, service workers--offer relatively low pay and few opportunities for advancement. Certainly women have made some progress moving into a broad range of jobs. Whether significantly greater numbers of women in the future are able to move into occupations that pay higher wages and offer more opportunities remains to be seen. As new occupations develop or others expand in response to technological change, women may find broader career opportunities than in the past, but this outcome is dependent upon their acquisition of the skills necessary for high-paying jobs, as well as the elimination of discriminatory barriers that act to exclude females from upper level and other well-paid positions.

Over 40 percent of black and Puerto Rican families are headed by females and the trend line is rising. Nine out of 10 of the 6.6 million single heads of household in the U.S. are women. One out of every three of these female household heads is living in poverty, even though 60 percent of them are in the labor force. A woman who has a child while still a teenager is especially "at risk" of being poor.

Blacks

During the 1970's, the black population grew by more than 10 percent to about 26.5 million people. In 1979, the black portion of the civilian labor force (16 years and over) was 12.3 million; BLS middle growth projections indicate that the black labor force will be 16.5 million in 1990. It is a relatively young population with a median age of just under 25. While the overall youth population is declining, the black youth population (16 to 24 years of age) will increase by 1 percent over the decade.

The economic and employment situation for educated blacks, especially those with postgraduate education, has improved somewhat and the black-white income gap has narrowed. But, for the great majority, their relative status seems to be about the same:

- Since the mid-1950's, the black unemployment rate has been about twice that of whites.

- Black teenage unemployment is almost three times that of white teenagers.

- Labor force participation by black males is declining; at present it is about 90 percent of that for white males.

- About one-third of all blacks had incomes below the poverty level in 1980.

- Blacks have a high dropout rate from high school. However, during the 1970's, the dropout rate declined from 30.5 percent to 23 percent among 18 to 21 year olds. The major issue here is the quality of education received.

What are the reasons for the economic and employment problems of blacks? The answer is complex. Racism and discrimination are still with us and must be counted as important factors. But there are other factors that must be taken into account. Major changes have taken place in the economy that have affected employment opportunities for blacks, beginning with the post World War II decline in agricultural employment. In many ways, increased technology and automation are just the latest in a series of such changes.

For young people not going to college or into the professions, retailing and manufacturing have been the traditional ports of entry to the world of work, especially in cities where a large proportion of blacks reside. Manufacturing has been moving out of our cities for more than two decades. The changing structure of retailing--whether it be the growth of suburban shopping malls or the growth of supermarkets and corresponding decline of corner grocery stories--has limited the opportunities for first and part-time jobs for many black inner city youngsters.

In addition, cities are changing. Some that have experienced economic decline are coming back not as manufacturing centers, but as national and regional headquarters and as service centers in finance, insurance, communications and law. They are centers that are making full and growing use of new technologies for the management and use of information. They are creating new jobs, many of which are going to suburban commuters. Because of higher dropout rates and the quality of education received, many black youth, but not all, lack the skills to compete in the changing labor market and the qualities desired by employers.

Hispanics

In September 1982 the Commission published Hispanics and Jobs: Barriers to Progress, from which these data are drawn. Hispanic-Americans are a growing part of the population: 6 1/2 percent of the population was Hispanic in 1980, up from 4 1/2 percent in 1970. That is 14.6 million Hispanics on the mainland and 3.2 million in Puerto Rico. Hispanics now constitute six percent of the working age population, and by 1990 it is projected that they will comprise at least 8 percent of the persons of working age.

Hispanics are also a young population. Half are under age 24 and almost one-third are under age 15, while half of the non-Hispanic white population is under age 30 and only 20 percent under age 15. Mexican-Americans and Puerto Ricans are on average even younger. Their median age is 22 years, while the Cuban-American median age is 36. The Hispanic youth population is growing at the same time that the overall youth population in the Nation is declining. For example, in 1980, eight percent of the 15-19 year olds were Hispanic. By 1990, it is projected that this will increase to about 10 percent.

It is important also to understand that Hispanics are a diverse population. On the mainland, Mexican-Americans make up about 60 percent of the Hispanic population; Puerto Ricans--18 percent; Central and South Americans--8 percent; Cuban-Americans--6 percent; and other Spanish, i.e., persons who are third or fourth generation Americans or who are of mixed Spanish heritage--12 percent.

The entire Hispanic population is concentrated in certain parts of the country. Two-thirds live in California, New York, Texas and Florida; less than one-third of the total U.S. population lives in these States. The different Hispanic groups are further concentrated within certain areas of the country. Ninety percent of all Mexican-Americans live in the southwest: southern California, Texas, Arizona, New Mexico and Colorado. Over 70 percent of the Puerto Ricans on the mainland are in New York, New Jersey, and Pennsylvania. Sixty percent of Cuban-Americans are concentrated in Florida and 25 percent in New York and New Jersey. Two-thirds of Central and South American Hispanics are located in California and New York. This regional distribution of Hispanics implies a need for national policies that are flexible across States. This is especially important for educational policies.

As a group, Hispanics experience high unemployment rates relative to whites, yearly incomes above blacks but below whites, low hourly earnings, and their high school dropout rates are higher than those of whites and blacks. They are more likely to be in blue-collar jobs than are whites or blacks.

When we look at employment problems among the different groups of Hispanics we find some problems specific to each group:

- Puerto Rican men and women have an especially hard time finding work as indicated by low rates of participation in the labor force and high rates of unemployment. This is true both on the island and on the mainland.

- Mexican-American men have the largest proportion in blue-collar jobs and they earn less per hour than any other group of men. Mexican-American women have high rates of unemployment and earn less than the other groups of Hispanic and non-Hispanic men and women.

- Compared to the other Hispanic groups, Cuban men and women, other than the Mariel refugees, do well in the labor market. Their participation in the labor force is high, unemployment is low and their median personal income is also high. On the other hand their income position is substantially below that of non-Hispanic whites. A substantial number of the recent Mariel refugees are low skilled and jobless.

Research shows that while the several groups experience different labor market problems, the major causes are the same: lack of proficiency in English, low levels of formal schooling, and discrimination in the labor market. In this context, "lack of proficiency in English" means not only a limited ability to speak and understand the language, but also an infrequent use of English.

- o Lack of proficiency in English is the most severe problem. In general, Hispanic men who have problems with English earn less than those who are proficient in English. For women, language difficulties are associated, on average, with reduced participation in the labor force.

- o Hispanics' low levels of education are another important reason for their low wages and poor occupational position. Lack of formal schooling has a particularly strong effect on the wages of Mexican-American men and women.

- o Language deficiencies are one vehicle through which discrimination against Hispanics occurs in the labor market. Even among men with similar language problems, Hispanics are in lower-paying jobs than non-Hispanics. Discrimination against Hispanic men on the basis of ethnic as well as linguistic characteristics contributes to their low wages, although the severity of discrimination as a problem varies among the several groups of Hispanic men. Discrimination has not been found to be a cause of differences in pay between Hispanic and non-Hispanic women, but all women, on average, receive lower wages than men.

I want to point out that these education and language problems are not restricted to immigrants. While it is true that more Hispanics are immigrant (one out of every four) than other groups in the population (one out of twenty), even U.S. natives who are Hispanic have education and language difficulties. To illustrate: native-born Mexican-Americans and mainland-born Puerto Ricans who are in their mid- to late-twenties average one year less schooling that non-Hispanic whites.

Youth

The 16- to 24-year old population will continue to decline. From a peak of 37 million in 1980, the number of 16- to 24-year olds will drop to around 24 million by 1990. Although the total number of youth will decline in this decade, two groups--Hispanics and blacks--will increase by about 1 percent.

The labor force share of 16- to 24-year olds is projected to drop from 24.4 percent in 1979 to 18.4 percent in 1990 and 17.0 percent in 1995. The numbers and share of young men will fall more rapidly than the numbers and share of young women. This means that by 1995 the labor force participation rates of young men and young women will be approximately equal.

Even though youth unemployment rates are about three times that of adults, it is important to remember that by the time most youth reach their mid-twenties they have made a successful transition--85 percent of all of them have graduated from high school, 20 percent have completed college, and most young men are averaging almost full-year employment.

There are four groups the Commission found who usually do not have such success. These are: young women, although the major problem for women is with the wages they earn, minorities, high school dropouts, and youth from low income families.

For women, the major problems are occupational segregation and lower wages. As several Commission studies have pointed out, discrimination, unstable jobs, and reduced access to career ladders are additional barriers to labor market success for blacks, Hispanics, high school dropouts, and persons with other disadvantages. These segments of the youth labor force will account for a higher proportion of the youth labor market of the next decade. This means that these problems will not evaporate because we are on the downside of the baby boom.

In recent weeks and months there has been a welcome refocusing on the performance of our educational system. Not only are we concerned about those for whom remedial programs financed through CETA and the Job Training Partnership Act (JTPA) are intended, but the concern is that general educational competence (measured by mastery of skills) has not risen along with educational attainment (measured by years of school completed). Even favorable demographics will not prevent high rates of youth unemployment if the youth and available jobs are not well matched. I stress basic skills because for most entry level jobs they are more important than specific vocational training, and, perhaps more important in the long run, they are vital to the ability of individuals to adapt to the changes that are inevitable during their careers.

Older Workers

The employment problems of older Americans will demand more attention in the coming years. While the baby-boom generation will not be in their fifties until the turn of the century, the median age of the labor force is already rising. This stems from improved health and longevity, as well as the aging of the population.

The National Commission for Employment Policy set out in 1982 to consider the employment situation of older Americans and to fill some gaps in the knowledge base. The Employment and Training Administration of the Department of Labor joined with the Commission to sponsor 12 research studies. I will highlight the findings of some of these studies that this Committee should have special interest in. The Commission will be making recommendations on employment policy for older workers during our September meeting. We will be happy to share with the Committees these recommendations and the individual studies when they are released during the summer.

About 14 million persons over age 55 were in the labor force in 1979--the same number as expected for 1995. However, while workers over age 55 made up about 14 percent of the labor force in 1979, they will comprise (according to BLS middle growth projections) less than 11 percent of the labor force in 1995. The numbers and percentages will probably increase dramatically in the next century as the baby boom cohort reaches their upper fifties.

One way to measure the extent of labor market problems by age for particular segments of the population is to use the eligibility criteria for employment and training services under the Comprehensive Employment and Training Act (CETA).

Using the CETA criteria of both economic disadvantage and either unemployment or underemployment, more than 10 percent of Americans age 45 and over could have been eligible for services at some point during 1980.

Older blacks, Hispanics, and other minorities were between two and four times more likely to have serious labor market difficulties than older whites in 1980. Older women were more likely than older men to have labor market problems. These problems, in general, seem to reflect a pattern of continued lifetime labor market difficulties experienced by these groups and not new problems brought about by aging itself.

One of our studies examined productivity and earnings among white male professional and managerial workers at a single high tech firm. It found that since older workers often have higher pay than younger workers, they and their employers have less incentive to invest in further training. This, in turn, affects their productivity and earnings. For this group of workers, aging and age discrimination seem to have less effect on the growth of their earnings than the fact that they have not increased their skills.

There has been concern about the plight of displaced older workers, defined as persons who left their previous jobs involuntarily, have no expectation of returning to that job, and who may have special labor market problems. The Commission funded two studies that focused on displaced older workers (by SRI International, and by Steve Sandell of the Commission staff with David Shapiro of Pennsylvania State University). The studies found that displaced older workers are not disadvantaged relative to other unemployed older workers in terms of previous education, previous employment histories, and health. However, displaced older workers experienced a longer period of unemployment, were less likely to be employed six months later, and had lower earnings during that six month period than younger displaced workers. Displaced older men experienced longer unemployment than other older male jobseekers (20 compared to 13 weeks). Older women spent about 20 weeks before they found a new job whether they were displaced or unemployed for other reasons.

Adult (Prime Age) Work Force

Women and men in the 25 to 54 age group are about 60 percent of the total work force at present, and are projected by BLS to represent nearly 70 percent of all workers by 1990. The proportions are even larger for total labor supply, since workers in the middle age group supply more hours, on average, than do younger or older workers. The growth in the male share of this group will all be due to the larger population base by 1990, since participation rates are expected to decline slightly. In addition to similar population changes for women, a substantial upward movement in participation rates in this age group is expected, from 62.2 percent in 1979 to 75.9 percent in 1990.

It has been noted often that the last 3 years of high unemployment have had greater relative impact on men in the 25 to 54 age group than on any other demographic sector. This is because the recession was particularly concentrated on the construction, manufacturing and transportation sectors where these workers dominate.

In addition to the cyclical dimensions of unemployment, there are structural dimensions which vary by industry and occupation. In this area, the Commission sponsored the initial research on displaced workers by Marc Bendick, from whom the Committee heard on June 9. We are continuing to study these issues in a number of ways, but a general point needs to be made about the relation between growth projections for an industry's output and for its employment. In addition to anticipated shrinkage or growth in production, technological change and productivity growth affect the numbers of workers needed and the kinds of skills they should possess. For a given level of output, having an older, more productive work force implies a need for fewer employees. The most adaptable and employable workers in any age group are likely to be those with strong general skills, while those whose skills are highly specific or obsolescent will have the most difficulty in adapting to change.

Summary

Demographic changes seem to be moving in the direction of a more mature and stable work force. A slower population growth rate during the 1980's should help ease competition for entry-level jobs and reduce the current high unemployment rate among teenagers. Tighter labor markets should help the black and Hispanic youth who will make up a sizeable proportion of new labor force entrants by the end of the decade, although their unemployment rates would probably remain unacceptably high. Tighter labor markets should also help women, who are expected to continue to enter or reenter the job market at increasing rates; however, low levels of income could be a persistent problem.

II. CHANGES IN THE WORKPLACE

I have talked about the composition of the work force. Now I want to turn briefly to some of the changes that can be expected to occur in the work place, focusing especially on issues surrounding technological change--the major concern of these hearings.

But first a few points need to be made to put these changes into a context.

(1) In looking at the types and location of jobs that will exist in the future, it is important that we not confuse long-run trends with the short term fluctuations in the business cycle. While the number of jobs did decline in 1982, projections indicate that employment will increase. According to the Council of Economic Advisers, about 107 million people are likely to be employed in 1985, compared with 99.5 million people in 1982. The Bureau of Labor Statistics has an even more optimistic picture--and here I'm citing their low trend projection--over 120 million people will be employed in 1990. BLS further projects that even in the automobile industry, employment will pick up, although it is unlikely to return to its prerecession (1979) level.

(2) The manufacturing sector will grow, albeit slowly. The consequence of this sector's slow growth is that there will be relatively fewer jobs in manufacturing in the future. For example, in 1979--before this recession began--21 percent of all jobs were in manufacturing; by 1990, a little less than 20 percent of all jobs will be in this sector.

(3) The entire U.S. economy has become increasingly internationalized. Exports and imports are becoming even larger shares of GNP. For all the advantages this implies, it leaves the U.S. more vulnerable to international economic situations over which it has little control.

Turning now to "technological change," there are three areas that people think of when talking about technology and employment: (1) high tech industries, (2) robotics, and (3) microelectronics. I want to make a few points about each of these.

(1) Within the manufacturing sector there are some industries commonly referred to as "high tech." These industries are defined in terms of research and development expenditures and by the percent of their work forces that are scientists, engineers and technicians.

These high tech industries are rapidly becoming important industries to the American economy, such as automobiles were in the last four decades, and as such affect the health of the economy and the health of a whole host of satellite services. Today, many of the high tech industries are leading sources of America's exports.

They are located not just in Texas and California; they are found in some of the older States as well. Illinois, New Jersey, New York, Ohio, and Pennsylvania each has 5 percent or more of all jobs in high tech industries.

Some of these high tech industries are projected to grow rapidly; for example, the growth in jobs in computers and related equipment is expected to be over 4 percent between 1979 and 1990. By contrast, jobs in the automotive industry will decline by one-half of one percent. Even with this rapid growth, however, high tech jobs will amount to only 22 percent of all jobs in manufacturing and 4 percent of all jobs in the economy.

These industries are likely to provide a major source of permanent job opportunities only for highly educated professionals. Even displaced workers, who have experience, are unlikely to have the technical skills necessary to compete for some of the jobs in the high tech industries; and other jobs in these industries--those on the assembly line--typically offer lower wages than those the displaced workers are accustomed to receiving.

Moreover, high tech industries may themselves become a source of some displacement. We have already seen examples of firms moving their plants overseas as mechanization permits increasing use of unskilled workers. While men have been the chief victims of permanent displacement in this recession, women who hold a large number of assembler jobs in high tech industries may soon become an increasing part of the displacement problem.

(2) The introduction of robotics into the workplace will have an impact on a few selected industries and a few selected occupations. The industries, known as the "metal working sector," are largely located in the Great Lakes region--Indiana, Illinois, Michigan, Ohio, and Wisconsin--and are also in New York and California. The jobs that are going to be affected are primarily semi-skilled and unskilled operatives, doing painting, welding, and machining.

The impact of robotics on employment and unemployment is likely to be subtle rather than dramatic. Massive displacement of older experienced workers is not expected. Estimates of the number of robots likely to be in place by the year 1990 or 2000 vary widely--partly because there are different definitions of precisely what a robot is. There seems to be a concensus that robotics will be introduced gradually into the workplace, as employees retire or leave the firm--and that workers who would otherwise be displaced are likely to be retrained by their companies.

What robotics may do is limit the number of job openings for young people, especially young men. The unskilled and semi-skilled jobs that they would otherwise have held may come to be performed automatically.

Still, robotics will be creating a whole new set of occupations--not just building the machinery, but also operating and maintaining it. Some of these new occupations require a high degree of skill, such as engineering. But other occupations--operating and monitoring--require little training. Maintenance work, while requiring some reasonably extensive prior intruction, appears to be accessible to persons experienced in machine maintenance generally. This information, in conjunction with the fact that industries using robots are located in the same region of the country as the displaced workers, suggests some hope that a match--over time--can be made.

(3) The impact of microelectronics will be felt across all industries, and concentrated within certain groups of workers, such as clerks, typists, and bank tellers. Like robotics, the introduction of such equipment as word processors in offices and scanners in retail stores is unlikely to cause massive displacement among those currently employed. Rather, the growth in employment opportunities for stock clerks, office clerks, and typists is likely to be curtailed. These are jobs which have typically been held by youth and women. Combining this projection with my earlier statements that (1) the youth population will be declining and (2) the rate of growth of women's participation in the work force will be slowing could make us sanguine about employment opportunities in the future for youth and women. This should not happen. Opportunities for entry-level jobs could decline more rapidly than the youth population. Further, those opportunities which will exist will not necessarily be located in the areas where minority youth--a growing population--live.

III. WHAT CAN POLICYMAKERS DO TO EFFECTIVELY RESPOND TO THESE CHANGES?

It is important to remember that while certain trends are apparent, the impact of all these changes and our ability to deal with them will be affected by the rapidity with which they take place and the extent to which we, as a Nation, are prepared to deal with them.

The pace at which changes occur will depend on a variety of factors, including the pace and extent of the economic recovery and the application of technological innovations, world trade decisions, the level of interest rates, energy costs, management decisions, the cost of labor, and last, but by no means least, the availability of a skilled work force.

Despite our uncertainty over the speed at which change will take place, some implications for policy seem obvious:

(1) We must emphasize the acquisition of basic skills for youth and adults. In its Fifth Annual Report, the Commission identified lack of basic skills as a major barrier to youth employment. This observation was repeated in our reports on vocational education and on Hispanics. This advice is confirmed by employers, by the recently released report from the National Commission on Excellence in Education, and by a myriad of others. Yet significant numbers of our youth fall behind and there is a large gap in available remediation services at the secondary school level.

When we look at the projections for job growth over the next 15 years, it appears at first glance that there are many low skill occupations in the top 20 — but many of these jobs will be different than in the past. The actual skill level may not be much higher but the jobs may require using basic skills in new ways or learning new skills. In the past, the basics of plumbing, electrical repair, etc., were often learned in the home. Today, people moving into occupations requiring basic knowledge of these skills often must rely on vocational courses to impart them. For example, "janitor" is a growing occupation. The Chrysler Institute in Detroit is operating an eight week retraining program for displaced workers to produce "building engineers"--janitors--and places all of its graduates.

For tomorrow's workplace basic skills must also include the ability to analyze and reason--to solve problems and to use computers. Hispanic and other non-English speaking students will need opportunities for language training.

Basic skills are also important to enable youth and adults to move up career ladders, to be able to take advantage of retraining opportunities, and to provide flexibility to adapt to a changing workplace.

(2) We cannot let the decline in the youth population in and of itself justify reducing education expenditures. We need to pursue excellence and efficiency in education. We never have adequately served the hardest to educate. Estimates of functional illiteracy, even among those who graduate from high school, are appalling (13 percent - white, 56 percent - Hispanic, 44 percent - black 17-year olds). We have learned lessons from employment and training programs that can be applied to education. Setting individual performance goals for students based on reading, comprehension, computation advancement, and problem-solving is possible, as is the measurement of basic vocational skill achievement. Computers have allowed teachers to develop individually-paced learning programs for students and to speed up the achievement of slow-learners. We have also learned how to condense courses, imparting the same information in a much shorter period of time. This is an especially effective tool for retraining displaced workers and youth needing remediation.

(3) More attention should be paid to the link between education and work and success in the workplace. Much has been learned about how students can successfully make the school to work transition--and resources need to be targetted to apply this information.

(4) Students and adults, business and labor leaders, educators and government officials must be prepared to be flexible to deal successfully with change. A student at the Control Data facility in Pittsburgh asked President Reagan during a recent visit: "How can you guarantee that after I finish this training program I could get a job, only to have it disappear after a few years?" The answer to that question today must be: "We can't, but retraining is an opportunity and its use should be perfectly natural." To make it so, however, will require changes in attitudes and changes in public and private practices.

On the private sector side, employers must be prepared and encouraged to offer more training and retraining before displacement occurs. On the public side, policies and programs have to be adaptable to meet changing individual and service delivery needs at the State and local level.

(5) We need to consider new approaches to financing adult training and retraining. We have programs in this country today which virtually guarantee any qualified young person access to higher education. However, adults are largely precluded from taking advantage of the two major sources of financial aid--the Guaranteed Student Loan program and the Pell Grants--unless they can attend school more than half time.

Large employers often provide upgrading and retraining for their workers but they can take a tax deduction only if the training is related to career advancement, not for a career shift. Similarly, individuals can claim a tax deduction when they invest in career-related training, but not when they pursue education for a new career. Should a substantial part of the adult work force be prohibited from getting retraining because they or their employers cannot affort it? The Commission is currently examining the need for adult retraining and financing options in this area.

(6) There needs to be more collaboration between business and education and government. The Job Training Partnership Act provides one model. Some States have extremely successful collaborative efforts; some individual companies have also been agressive in this area. Adopt-a-school efforts in Boston, Oakland, and Houston provide additional models of private/public partnerships.

A recent survey of business, educators, and organized labor, prepared for the Center for Public Resources, found that a large gap exists between business' perception of the job schools are doing to prepare youngsters for the work place and the perceptions of educators. Seventy-five percent of the business leaders reported significant basic skills deficiencies in high school graduates at the time of job entry while 70 percent of the educators felt the majority of their employment-bound students were adequately prepared. (Basic Skills in the U.S. Work Force, The Center for Public Resources, 1982.)

(7) *Early intervention to assist displaced workers is needed before plants close or large permanent layoffs occur*. Several promising programs have been designed to help in these situations, such as the business- and labor-negotiated early warning and action schemes offered by the Canadian Manpower Consultative Service. The Canadian government provides consulting services and funds to joint business/labor committees to help them facilitate worker adjustment before plants close or large scale layoffs occur. The State of California is experimenting with its own intervention model. Presumably, some States will consider using funds under title III of the new Job Training Partnership Act to provide similar services.

(8) *The Unemployment Insurance (UI) system needs to be linked with readjustment services for displaced workers*. For those facing permanent displacement, extended receipt of UI, by itself, can delay rather than help adjustment. Likewise, the variety of special adjustment assistance programs, such as Trade Adjustment Assistance and the Redwood Employee Protection Program, have been faulted for providing incentives to stay unemployed longer, delaying the ultimate adjustment until benefits have run out.

Unemployment Insurance benefits can provide income support while claimants are actively engaged in activities designed to speed readjustment. The Commission believes that at week 13 in the benefit period all claimants should be interviewed so that the cause of their continued unemployment can be determined. We chose week 13 because the average duration of UI claims in nonrecessionary times is 10 to 13 weeks.

Claimants identified as displaced workers would enter a program offering a set of services structured to encourage reemployment while continuing to receive UI. These services could very well be financed by title III of the Job Training Partnership Act.

(9) *We must continue both public and private efforts to eliminate discrimination*.

(10) States and localities need to develop their own employment strategies. The Job Training Partnership Act provides a tremendous opportunity to States and localities that want to do more than carry out another Federal program. While a major responsibility for the health of the national economy rests with the Federal government because it makes a myriad of monetary, fiscal, defense, trade, and foreign policy decisions that greatly affect employment at the State and local level, States have the major responsibility for education, welfare, economic development, and licensing policies. The Job Training Partnership Act has now given States more responsibilities than ever before for job training and labor exchange (Job Service) policy. All of the major ingredients are there for the States to use the Job Training Act mechanism to forge comprehensive State employment policies.

Training and retraining program decisions are best made at the local level with input from business, labor, government, education, and community groups. The Job Training Partnership Act provides a mechanism for developing comprehensive local employment strategies to deal with problems faced by the disadvantaged, and that can also have a positive impact on other youth and adults within the community.

(11) The Federal Government should establish a new priority for employment in the development of its overall economic policies. The United States, unlike many other nations, does not have a comprehensive national employment policy to facilitate the adjustment to current and future economic challenges. This is not entirely surprising, considering that the U.S. is a Nation of over 230 million people with a decentralized form of government, a highly diverse and independent educational system, and a strong adherence to the idea of a free market economy. But this is not to say that a uniquely American employment policy cannot be developed to address the employment needs of the American people and the American economy well into the twenty-first century. We have the components for developing a workable policy, but Federal decisions in education, trade, economic development, job training, defense, revenue collection, and other areas are largely uncoordinated and occasionally work at cross purposes. More attention must be paid in the development of Federal policies to their affect on employment.

In closing, let me again thank you for inviting me to appear on behalf of the National Commission for Employment Policy. For Ken Smith, our Chairman, the Commissioners, the staff, and myself, let me encourage you to call on us in the future.

Submitted by Patricia Hogue

National Commission for Employment Policy

8th Annual Report

The Work Revolution

NCEP
National Commission for Employment Policy

Members of the National Commission for Employment Policy

Kenneth M. Smith, Chairman
President and Chief Executive Officer, International Management and Development Group, Inc.

Terrel H. Bell, Secretary of Education

Richard S. Schweiker, Secretary of Health and Human Services

Raymond J. Donovan, Secretary of Labor

Harry N. Walters, Administrator of Veterans Affairs, Veterans Administration

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Norma Pace, Senior Vice President, American Paper Institute

Roderick R. Paige, Professor of Education, Texas Southern University

Kenneth O. Stout, Executive Director, Arctic Enterprises, Inc.

Patricia W. Hogue, Director

To the President and Congress of the United States

December 8, 1982

The National Commission for Employment Policy is particularly pleased to provide this *Eighth Annual Report* of the Commission for your review and consideration. You will note that, in a departure from past reports, the Commission is examining employment in terms of fundamental, long-range economic changes. We are, of course, acutely aware of and deeply concerned about current high unemployment rates. We believe, however, that business, labor, and government working together in the spirit of partnership exemplified by the Job Training Partnership Act of 1982 can be successful in overcoming the current and prospective problems of cyclical unemployment. Our report focuses on where these problems appear to lie and possible long-term solutions that might facilitate the process of change.

The Commission is especially impressed with the magnitude of the changes underway in the labor market and the effects that these changes will have on the rate of structural unemployment. Workers displaced from their jobs in manufacturing industries after many years of gainful employment, youth who are unprepared for entry-level positions in many skilled occupations, and persons who are chronically unemployed or underemployed are certain to face even more limited job prospects in the future as the technological advances already underway accelerate throughout the 1980's and 1990's. In response to this important challenge, policymakers need to consider how the education system, public and private job training programs, unemployment insurance, the employment service, and a host of other existing policies and programs can better assist these groups to participate successfully in the process of change.

The last section of this report lists some basic questions that, we believe, policymakers should address in formulating employment policies suitable for the 1980's and beyond. The Commission undertook work in several related areas over the past year, including (1) a multifaceted study of the labor market problems of older Americans and national policies that affect them, (2) an analysis of the employment needs of private business firms, and (3) a major project just getting underway to consider various ways to assist displaced workers, (4) a recently completed major study on the job market problems of Hispanic-Americans, a group whose numbers and importance in the U.S. labor market are expected to grow.

Our intent in these and other projects planned for 1983 is to explore fully the implications of projected labor market changes and to draw out from them specific recommendations that can lead to effective employment policies at the national, State, and local levels. The Commission recognizes and urges policymakers to be sensitive to the fact that the United States has a diverse economy and that policies developed for the Nation as a whole may not be suitable for all States and localities. We will, therefore, address in each project the level of governmental and private sector responsibility that is called for.

We deeply appreciate the confidence demonstrated in us by the reauthorization of our Commission under the Job Training Partnership Act. Recognizing that we have entered a period of momentous change that will require the most dedicated efforts to develop effective employment policies in each sector attuned to future needs, we pledge to do our utmost to provide sound guidance on employment matters.

Kenneth M. Smith
Chairman

Terrel H. Bell, Secretary of Education

Richard S. Schweiker, Secretary of Health and Human Services

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Part I
The Work Revolution

The 1980's are proving to be a period of tremendous change in the labor market. Among the trends that business and government leaders must consider in fashioning effective employment policies are a significant decline in labor force growth, a maturing work force, and large-scale movements of people from the Northeast and Midwest toward the West and the South and from urban to rural areas. In addition, high technology innovations, including computers and industrial robots, and the emergence of an increasingly service-oriented economy promise to alter significantly the number and kind of employment opportunities available during the remainder of this century. The following report examines these very important labor market changes as a first step in developing employment policies that will serve the needs of this Nation in the 1980's and beyond.

The Changing Labor Force

Dramatic changes are taking place within the American work force. Some 125 million persons will be in the labor force at the end of the current decade, according to projections by the Bureau of Labor Statistics (BLS) in the U.S. Department of Labor. The typical worker is expected to be older, better educated, and more likely to live in a rural area than today's employee. "He" is also more likely to be a "she" as the number of working women continues the growth begun after World War II, although at a slower rate than in the past. Among youthful labor force entrants, the proportion of black and Hispanic youths is expected to increase.

Growing Slowly, Growing Older

The population of the United States has increased throughout this century and is expected to reach 244 million by 1990. The rate of growth, however, slowed considerably in the 1960's and 1970's. The 1980 census data confirm what demographers have known for some time, that the reduced birth rates that followed the great post-World War II "baby boom" will mean a shrinking supply of new workers in the current decade (chart 1).

The U.S. population in the 16- to 24-year age range peaked at 37 million in 1980, after more than 20 years of growth, with nearly 26 million young people at work. Based on Current Population Survey reports from the Bureau of the Census, the U.S. Department of Labor projects a continuing decrease of this age group in the work force over the remainder of the decade. By 1990, the number of 16- to 24-year-old workers will have declined to around 24 million. By 1995, a drop of another million in this age range is expected. The diminishing supply of young workers, together with a slowdown in the rate at which women enter the labor force, lead experts to predict that in the 1980's the labor force will grow at less than half the rate it grew in the 1970's.

Prime-age (22- to 44-year-old) workers are expected to number nearly 60.5 million by 1990, according to BLS projections. Within this group, the greatest growth will occur among workers aged 35 to 44 (the maturing baby-boom generation). Nearly 38 million of these workers will be in the labor force by the end of the current decade.

At the upper end of the age spectrum, the U.S. Department of Labor projects a slight decrease in the number of persons 55 years and older who are in the labor force—from around 14.7 million workers in 1980 to about 14.1 million in 1990. Most of this decrease is expected to occur among males in the 55- to 64-year-old category.

Chart 2 illustrates the change in age composition of the labor force from 1970 to 1990, as projected by the U.S. Department of Labor. The effects of these changes on the economy will be significant. Smaller numbers of young entry-level workers should create tighter labor markets, including higher wage rates and less unemployment. These, in turn, are likely to persuade older workers to remain longer on the job. The result could well be an increase in the average retirement age and a host of related policy implications for government.

A maturing population is also expected to have major repercussions on business behavior—reflected in hiring and pension policies but also affecting product development and marketing. For example, employers who have previously relied on young people for a large share of their work force (the fast food industry, for example) may need to alter their labor force composition to take into account the shrinking supply of young workers. Similarly, the manufacturers of products specifically designed for a youth market should see a downturn in demand compared with products and services that are attractive to middle-aged and older persons. Pension and health care planning will likely take on far greater importance as the labor force ages, with concerns about the fiscal soundness of the Social Security program and other pension systems already appearing more frequently in public discussions.

Exceptions to the Rule

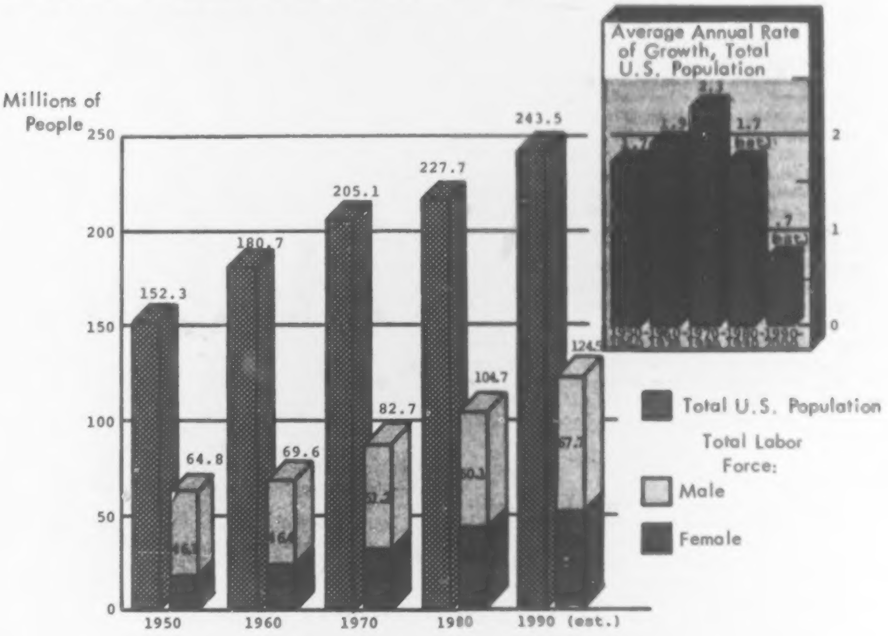
Although the total number of youth in the work force will decline in this decade, two groups—blacks and Hispanics—will not share in this downward trend. The census of 1980 shows that blacks accounted for just under 12 percent of the total U.S. population and had a median age of 24.9 years, compared with a median age of 31.3 years for whites. (See chart 3.) The Spanish-origin population in 1980 made up 6.4 percent of the total U.S.

population and had a median age of ony 23.2 years. A combination of a younger-than-average population and a high birth rate indicates a continuing population expansion and a growing supply of new labor from these two groups during the 1990's. Thus, while the total number of men and women in the labor force between the ages of 16 and 24 is expected to decrease by nearly 9 percent for whites, it is anticipated that it will increase about 1 percent for blacks and other minorities.

The exact number of Hispanics in the population will be determined in part by birth rates and in part by the flow of immigrants—both legal and illegal—from Mexico and from Latin American countries. If the rate of immigration is low, some analysts predict that Hispanics may account for nearly 10 percent of the population by the year 2000. If the flow of immigrants is large, the percentage of Hispanics could rise another 2 or 3 percentage points by the turn of the century.

The effect of immigration on the size and average age of the work force is, in fact, one of the imponderables for demographers making population projections. About 450,000 immigrants from all countries enter the U.S. legally each year. There may also be between 4 and 6 million undocumented workers currently living in the United States. Many of them have made their way here from Mexico and other Latin American countries. Despite current concern about the impact of undocumented workers on U.S. employment, recent research suggests that the projected major decline in new labor force entrants in the next decade could raise the issue of *encouraging* immigration as a source of needed additional labor, although efforts to utilize more effectively the existing labor supply (including efforts to eliminate discrimination) logically should precede outreach efforts to attract immigrants as a source of workers. Nevertheless, this is one of the critical labor force

Chart 1. The total U.S. population and labor force will continue to grow during the 1980's and 1990's, although at a slower pace than in earlier decades.



Source: U.S. Bureau of the Census and Bureau of Labor Statistics.

issues that may take on an entirely new perspective as we approach the year 2000.

Women in the Workplace

There is no uncertainty about the fact of increased participation of women in the workplace. Women have accounted for about 60 percent of the net growth of the labor force since World War II. This fact represents one of the most revolutionary employment changes of the postwar period. (See chart 4.) Moreover, the trend is expected to continue throughout the decade, even though the actual rate of increase will slow.

Particularly striking is the rate at which married women, with husbands present, have entered the work force. Half of all married women were in the labor force in 1980. Not only are married women (many with preschool-age children) looking for and finding jobs outside the home, but they are staying in the labor force longer and spending less time out of the work force for child-rearing.

The effects of this trend are far reaching. In just one example, work by a Commission staff analyst indicates that by the year 2000 as many as 80 percent of the women reaching the age of 65 will qualify for Social Security retirement benefits on the basis of their own earnings, a significant factor in the development of retirement and pension policies.

More immediate issues are also involved in the increased labor force participation of women. For example, 9 out of 10 of the 6.6 million single heads of household in the U.S. are women. One out of every 3 of these female household heads is living in poverty, even though 60 percent of them are in the labor force (chart 5). Most of those who are working tend to be employed in occupations traditionally reserved for women such as clerical or secretarial work, retail and service trades—jobs that, in the past, have tended to be associated with low pay and limited advancement opportunity.

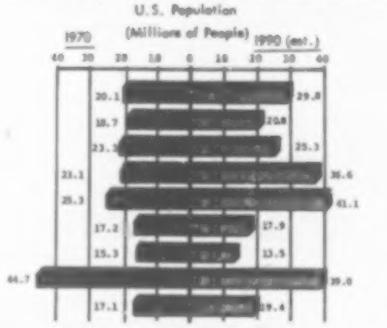
Whether women are able to increase their earnings significantly depends to a large extent on their ability to move into occupations that pay higher wages than these traditional occupations. As new occupations develop or others expand in response to technological change, women may find broader career opportunities than in the past, but this outcome is dependent upon their acquisition of the skills necessary for high-paying jobs, as well as the elimination of discriminatory barriers that act to exclude females from upper level and other well-paid positions.

Shifting Toward the Sun

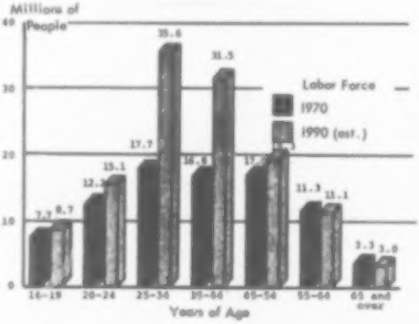
Among the population trends confirmed by the 1980 census is a movement of people from the industrial areas of the Northeast and Midwest toward new homes in the South and West. (See chart 6.) Aggressive economic development policies, including tax incentives for businesses that relocated, along with noneconomic inducements such as a warm climate and a relaxed lifestyle, attracted many new industries and people to these areas. In turn, they created a growing number of jobs that served as a catalyst for a massive interstate migration during the 1970's. If these trends continue, demographers predict that, for the first time in U.S. history, the combined population of the South and West will exceed the combined population of the North and East by 1990.

More than a third of all Americans—over 80 million people—now live in the southern tier of States that stretches in a broad band from California in the West to the North Carolina-to-Florida coastal area in the East. The population of this "Sun Belt" increased by 23 percent from 1970 to 1980, double the rate for the U.S. population as a whole. Although the Sun Belt generally experienced much greater growth and prosperity than the industrialized areas of the Northeast and Midwest throughout the 1970's, the region is by no means monolithic. The Sun Belt

Chart 2. By 1990, the number of people between the ages of 25 and 44 is expected to have grown considerably as the "Baby Boom" cohort matures...

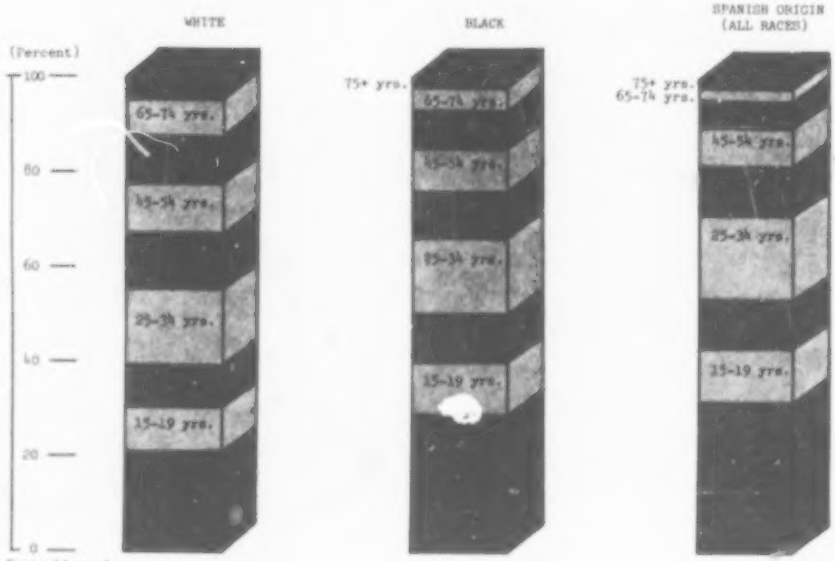


...and this growth will be reflected in an older labor force.



Source: U.S. Bureau of the Census and Bureau of Labor Statistics.

Chart 3. Blacks and persons of Spanish origin in the United States are younger on average and have higher fertility rates than whites.



	WHITE	BLACK	SPANISH ORIGIN (ALL RACES)
Proportion of U.S. Population..........	83.2 Percent	11.7 Percent	6.4 Percent
Median Age.....	31.3 Years	24.9 Years	23.2 Years
Fertility Rate*..........	68.5	81.3	99.2

*Births per 1,000 women, age 18 to 44 years.

Source: U.S. Bureau of the Census.

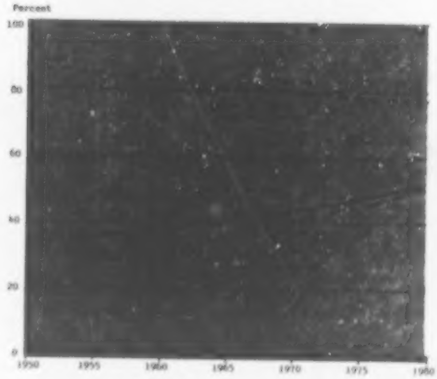
encompasses a number of clearly defined subregions with different economic bases and important cultural variations.

- Arizona, with a population increase of 53.1 percent from 1970 to 1980, had the highest growth rate of any single State in the Sun Belt. As a subregion, Arizona and New Mexico together averaged a growth rate of 40.5 percent in this period. Tourism and rapidly expanding job opportunities in high technology industries are among the area's chief attractions. Phoenix, Tucson, and Albuquerque have become electronics manufacturing centers, and several national corporations have moved their headquarters to these expanding cities.

- Florida, second only to Arizona in its percentage of population increase, grew by over 43 percent from 1970 to 1980. The State's reputation as a retirement haven and its role as the receiver of successive waves of Hispanic, Asian, and Haitian refugees have contributed to its high growth rate. Aerospace and other high-tech industries, as well as tourism, are major sources of jobs in the State.

- Texas, Oklahoma, and parts of Louisiana (the Nation's "oil patch" region) benefitted greatly from the boom in oil and gas production after the price increases of the 1970's. Together, the three States averaged a population increase of 30.2 percent, with Texas becoming the third most

Chart 4. The labor force participation rates of women have risen steadily over the last 30 years.



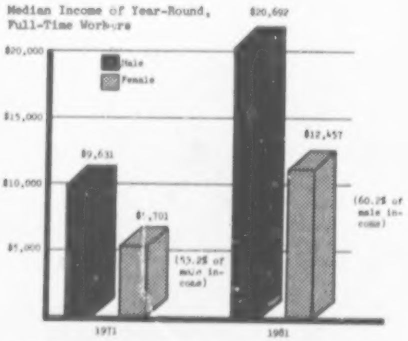
Source: Bureau of Labor Statistics.

populous State after California and New York in that period. Petrochemicals, plastics, and other forms of manufacturing helped attract many new workers to the area in the 1970's. Recently, increases in world oil and gas supplies, which contributed to lowered prices, have led to a cutback in production and a slowdown in employment growth in this region.

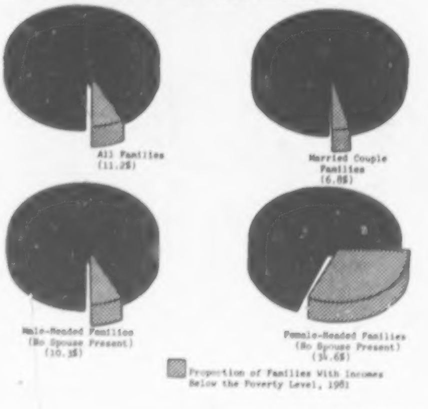
- California—wealthy, cosmopolitan, and economically diverse—has been growing steadily for many years and was in the vanguard of the population shift toward the West long before the 1970's. Consequently, its economy is more mature than some other areas of the Sun Belt, and its growth from 1970 to 1980, 18.5 percent, was the second lowest of the five subregions described here.
- The seven States that constitute the South/Southeastern region of the country (Alabama, Arkansas, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee) rely more heavily on durable goods manufacturing than the other Sun Belt subregions. As a result, their prosperity has been more vulnerable to recent national economic problems that focused on these industries. In addition, the population was initially larger than the more sparsely settled West. Reflecting these circumstances, the South/Southeast had the lowest population gain, 16.8 percent, of all the Sun Belt's subregions in the 1970's, although it still grew nearly 1½ times the national average of 11.4 percent.

Several western States, not included in the Sun Belt, also experienced rapid growth during the 1970's. Indeed, Nevada, with a population increase of 63.5 percent, led *all* States in terms of population growth in that decade. Colorado, Idaho, Utah, and Alaska all had growth rates above 30 percent in the 1970's while the population of Wyoming increased by over 40 percent. Jobs related to processing mineral ores, lumber, and other natural resources were major attractions in these States.

Chart 5. Women as a group lag behind men in earnings...



...so that families headed by women are more likely to be poor than are other families.



Source: Bureau of Labor Statistics.

Whether the relative prosperity of these rapid-growth areas persists over time will depend on several factors. Continued expansion of the new industries that attracted workers to these areas is one important determinant. Throughout the South and

West, the ability of unskilled and semiskilled workers to find jobs has declined considerably in recent months so that the movement of workers from other parts of the country into these regions may be slowed. Natural resources are another limiting factor. Problems associated with land usage, water rights, and pollution will have an important impact on future growth. Nevertheless, for the remainder of the 1980's it is expected that the proportion of the U.S. population residing in the South and West will continue to increase, and the job imbalances that accompany regional expansion and decline will need to be addressed by employment policymakers.

In addition to these major regional population shifts, smaller movements of people in the 1970's have also been noted by demographers. For the first time since the early 1800's, rural areas and small towns grew more rapidly than metropolitan areas during this period (chart 7), a shift that reflects the availability of good transportation and communications facilities. As part of this trend, suburban growth has continued since the 1950's, and large numbers of blacks and other minority group members have joined that migration. Like the broader movement to the South and West, these population shifts are responsible for altering the supply of labor that may be available to an industry in a given area and must be considered in the development of comprehensive employment policies.

Changes in Industries and Occupations

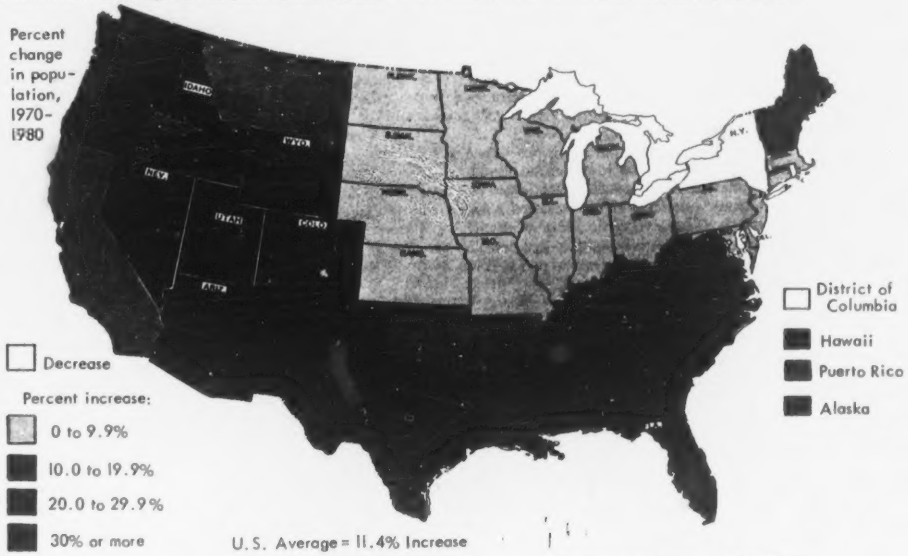
Changes in the workplace are expected to be as profound as the changes in the work force throughout the remainder of this century. The occupational profile of American workers is already undergoing significant alterations in response to the development of new industries, the disappearance of jobs in some older manufacturing industries due to foreign competition, and the emergence of an increasingly service-oriented economy (chart 8).

A High Technology Blitz

The growing prosperity that has changed the face of much of the South and West in the past decade has been spurred by a surge of new high technology industries, such as electronics, computers, and aerospace. An explosive growth in computer-related jobs, microprocessing, robotics, and other advanced forms of automation began in the 1970's and shows no signs of slowing in the 1980's. This growth has been likened to the original Industrial Revolution and, indeed, is viewed by some analysts as a new phase of that momentous process of economic and social change.

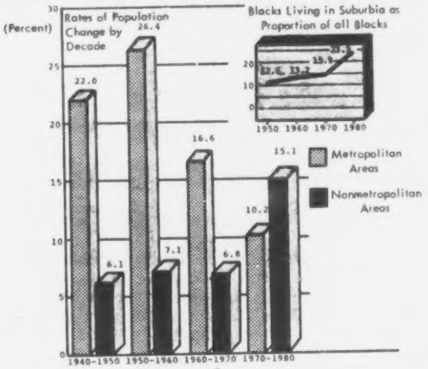
England and other western European countries, as well as the United States, faced profound alterations in the nature of

Chart 6. Interstate migration helped expand population dramatically in the South and West during the 1970's.



Source: U.S. Bureau of the Census.

Chart 7. The growth of nonmetropolitan areas exceeded the growth of metropolitan areas during the 1970's, reversing a trend of several decades.



Source: U.S. Bureau of the Census.

production and work during the early 19th century as the result of rapid industrial development made possible by the steam engine. Today, the United States and other advanced nations appear to be at the beginning of a high-technology age, stemming largely from the development and industrial application of computers. These new forms of automation, in the short term at least, may have severe dislocating effects on workers in the 1980's, just as the development of earlier forms of automated production machinery had on workers in the 1800's.

The problem is even more complex today, however, since workers may be threatened in the short term by loss of their jobs due to rapid automation of manufacturing plants and in the long term by the possible crippling of whole industries if manufacturers fail to automate rapidly enough or otherwise change their production techniques or wage costs to meet foreign competition. That the Nation's unemployment rate exceeded 10 percent for the first time in 4 decades in September 1982, reflects not only the current recession, but also the disappearance of thousands of jobs in traditional "smokestack industries" such as iron, rubber, and steel, as well as in automobile manufacturing and other basic industries. Many workers in these industries who previously enjoyed both security and high salaries have consequently been left without work and often without applicable skills to compete in an emerging high-technology economy.

Industrial Robots

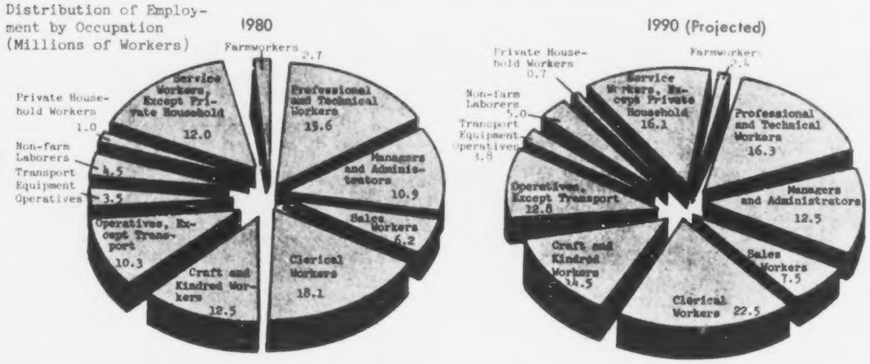
Industrial robots ("iron-collar workers," as they are sometimes referred to) are of particular concern to many blue-collar workers in manufacturing industries. Although simple industrial robots have been available for the past two decades, the United States now appears to be on the brink of a market explosion in robotics, as several of the largest U.S. corporations (Westinghouse, General Electric, General Motors, Chrysler, and others) have begun to make a major commitment to the new technology and convert to more automated manufacturing processes. The desire to increase productivity is an important impetus for this decision, and foreign trade competition from Japan—the world leader in the use of robots—has spurred their application within the United States.

Along with greater use of these machines has come a growing sophistication in their design. Unlike the androids depicted in *Star Wars* and other popular space-oriented fiction, first-generation robots have usually been limited in function, consisting mainly of machines with armlike projections that grip objects and move them from place to place. (See the descriptions in chart 9.) The latest computer-controlled robots display much more diversity, however, and are able to perform many of the "thinking" tasks that would normally be done by humans. If the major computer firms begin large-scale manufacturing of production robots, as several have already indicated an interest in doing, it is likely that demand will be stimulated further by an expected drop in prices, and even more sophisticated robots will be forthcoming.

The long-term, net effect on employment of these latest advances in technology cannot be predicted with accuracy even though short-run dislocations are already apparent. One school of thought holds that widespread use of computerized robots in manufacturing will reduce the total number of jobs in goods-producing industries and permanently displace many skilled and semiskilled workers now engaged in manufacturing. Researchers at Carnegie-Mellon University's Robotics Institute, for example, concluded after a recent study that the simplest, first-generation robots now in use have the potential to replace about one million of the nine million currently employed operating manufacturing workers. Most severely affected would be those workers engaged in production activities such as welding, painting, and operating machine tools. As new, more advanced generations of robots are introduced, these researchers contend, an additional three million jobs will be at risk in the areas of assembling, packaging, grinding, electroplating, and inspecting. Unfortunately, workers who are idled through industry shrinkage are unlikely to have the specific skills necessary to fill newly developed positions in emerging industries. Indeed, it may be very difficult, if not impossible, for those who lack related education and training to find even entry-level jobs in fully automated manufacturing industries.

While predictions of this nature have generated widespread concern among some economic forecasters, others find much to be hopeful about in this new round of automation. If, for example, robotics and other forms of advanced technology allow manufacturers to decrease the price of goods by increasing efficiency, the resultant demand for such products could actually increase the total number of jobs, although skill requirements may be altered substantially. The net effect of these changes would then be one of increased productivity, economic growth, and employment expansion. Improved working conditions are another potential benefit as robots take on the most difficult and dangerous jobs in industry. And, finally, automation may be the most economical means of restoring the Nation's industrial base.

Chart 8. The occupational profile of the United States will undergo significant changes in the 1980's.



Sample Occupations That Will...

Decline	Expand	Offer New Job Prospects for the Future
• Shoemaking-machine operators	• Data-processing-machine mechanics	• Industrial-robot production
• Farm laborers, owners, and tenants	• Computer-systems operators and analysts	• Energy technicians
• Housekeepers, private household	• Office-machine services	• Industrial-laser processing
• Secondary-school teachers	• Aero-astronautic engineers	• Genetic engineering
• Bus drivers	• Fast-food service workers	• Bionic medical electronics

Source: Bureau of Labor Statistics.

Those who hold that automation's positive effects will outweigh the negative point to history as a guide, since overall, despite some immediate worker hardship, the mechanization of agriculture and manufacturing over the past century has been the source for rapid productivity growth, wage gains, reductions in hours worked, and other employee benefits. These optimistic observers believe that, given sufficient lead time, a concerted effort to retrain workers displaced by the new devices and techniques could ameliorate much of the hardship associated with short-term worker dislocations. The Carnegie-Mellon study, itself, cautions that the job losses predicted following the introduction of robots will take place over *at least* a 20-year time span. Thus, retraining, plus a strong growth in other areas of the economy, may be able to alleviate much of any displacement problem.

The Information Age

The changes that have occurred in information occupations as a result of advances in telecommunication and computer technologies may be even more revolutionary than the development of robotics and other forms of automation in manufacturing. One estimate of labor force activity suggest that about 55 percent of all workers in 1980 were engaged in some kind of information-related occupation—generating, storing, transmitting, or otherwise manipulating data. Computers, micro-chips, satellite TV, and other advanced communications technology have all increased the quantity and speed of information handling and have contributed thereby to the exponentially increasing demand for more data.

Like robots in manufacturing, the effect of these changes on employment appear mixed. Computer programmers and cable

A ROBOT'S WHO'S WHO

INDUSTRIAL ROBOTS: Have armlike projections and grippers that perform factory work generally done by humans. The term is usually reserved for machines with a built-in control system and capable of operating without human assistance. In contrast, Japan counts as robots manipulators operated by humans, either directly or remotely.

PICK-AND-PLACE ROBOTS: Account for one-third of all U.S. mechanical installations. The simplest form of robot — moves objects from one place to another — usually limited to up and down, left and right, in and out movements. Electro-mechanical control system. Cost: $5,000 to $30,000.

SERVO ROBOTS: Most common industrial robot — can include all robots described below. Name derived from the servomechanisms that permit the arm and gripper to alter direction in midair, without requiring mechanical switching. Five to seven directional movements can occur, depending on the number of "joints" in a robot's arm.

PROGRAMMABLE ROBOTS: Servo robots directed by a programmable computer that can repeat indefinitely a sequence of arm-and-gripper movements. Can be reprogrammed by being led mechanically through a new sequence. Price range: $25,000 to $90,000.

COMPUTERIZED ROBOTS: Servo robots directed by a computer that can be reprogrammed electronically and can independently improve on their work-routine instructions. Price: $35,000 and up.

SENSORY ROBOTS: Computerized robots with one or more artificial senses such as sight and touch. Price: $75,000 and up.

ASSEMBLY ROBOTS: Computerized robots (sometimes very anthropomorphic), designed specifically for assembly-line jobs.

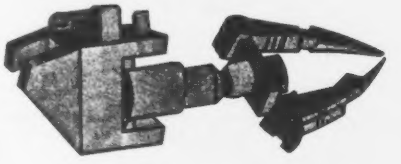
Chart 9. "Iron-Collar Workers" will join the U.S. labor force at increasing rates during the 1980's.

RIA* ESTIMATES OF THE WORLD ROBOT "POPULATION" (1979)

JAPAN	47,000**	POLAND	720	ENGLAND	185
W. GERMANY	5,850	SWEDEN	600	FINLAND	130
UNITED STATES	3,255	NORWAY	200	BELGIUM	20

*Robot Institute of America.

**Includes all mechanical manipulators; 7,500 considered comparable to count in other countries.



Source: Business Week, June 9, 1980, p. 64.

TV installers are two of the many new jobs that have been created. Nevertheless, as part of the continuing dynamics of change, other jobs have already been eliminated or are likely to be. For example, as computers are used more extensively to store information and perform billing, payroll, and other calculations, the number of file and billing clerks and many other office machine operators that are needed for these operations will continue to decline. Even within emerging occupations, some previously new jobs (key punchers, for example) are beginning to disappear as more advanced machines take over basic computer functions. Once again, the net impact on workers will depend not on change in itself but on the speed of that change and the ability of individuals to accommodate quickly any short-run job imbalances that result.

Our Service Economy

Robots, computers, satellite communications, and other forms of high technology are dramatic examples of change that have captured headlines. A less dramatic, but equally profound change, stems from the accelerating shift toward a service economy, which began after World War II. (See chart 10.)

Of some 43 million wage earners (excluding domestic servants and the self-employed) in 1940, 56 percent worked in industries that produced goods through farming, construction, mining, and manufacturing. In 1980, these workers accounted for only 31 percent of the total work force. Conversely, from 1940 to 1980, the proportion of the Nation's workers employed in industries that provide services, such as health care, wholesale and retail trade, education, repair and maintenance, government, transportation, banking, and insurance, increased from 44 to 69 percent.

Ninety percent of all new jobs added to the economy from 1969 to 1976 were in service occupations. This striking statistic highlights a trend that is expected to continue until, by 1990, 72 percent of the labor force (over 89 million workers) will be employed in service-producing industries. One further telling indication of this trend is apparent in union membership statistics. The United Auto Workers and the United Steelworkers of America, which in 1960 were the two largest unions in the AFL-CIO, by 1980 had been surpassed in membership size by the United Food and Commercial Workers (grocery clerks and meat cutters) and the American Federation of State, County, and Municipal Employees.

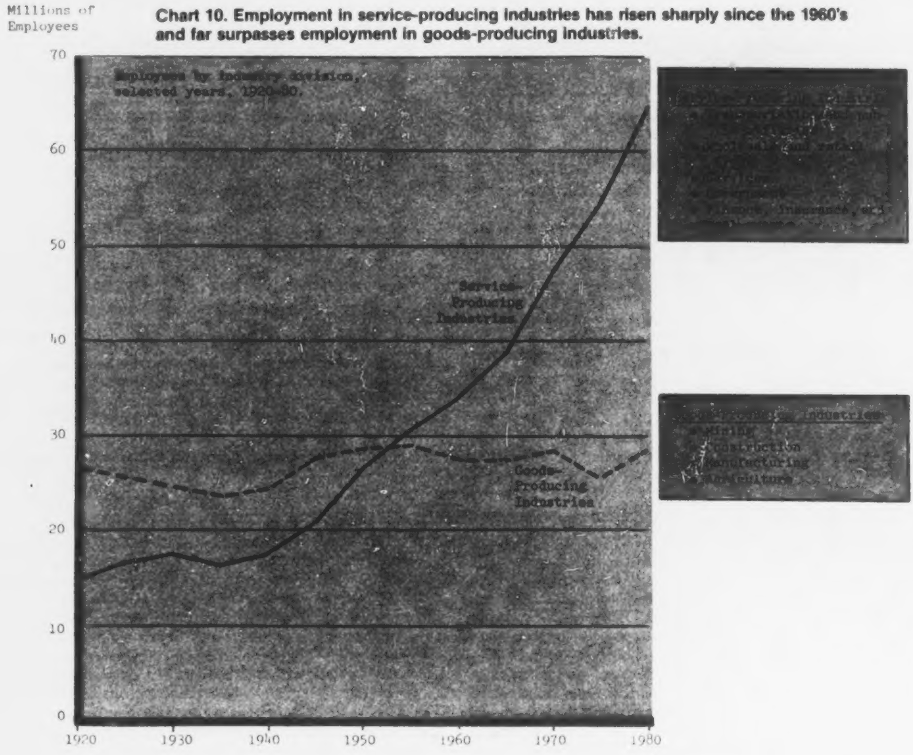
Social and demographic changes are leading factors in the rapid growth of service occupations. As more women have entered the workplace and as family incomes in two-wage-earner families have risen, there has been more use of commercial cleaning establishments, restaurants, and other personal and child care providers. The need for health and medical care services are also likely to increase as the general population ages. Other contributing growth factors include the expansion of cities and suburbs, which require additional government services, the growth of banking, credit, and real estate industries in response to an expanding population, and, as indicated above, the burgeoning demand for the production and manipulation of data that has accompanied the development of computers and telecommunications devices.

The growth of service-sector jobs, particularly health care and other personal services, could provide many new job opportunities in the future. Unskilled and semiskilled workers who may be dislocated from older manufacturing jobs and whose reemployment prospects in some of the new high-tech industries also may be limited are among those workers who could benefit from the growth of service-sector jobs. Whether there will be enough new employment opportunities to meet the demand, however, is open to question. Moreover, service jobs that do not require much specialized training have traditionally paid far less than manufacturing work. There is also the very real problem of psychological and other personal adjustments required by career changes that may be essentially involuntary and far removed from the type of work originally chosen.

White-Collar vs. Blue-Collar

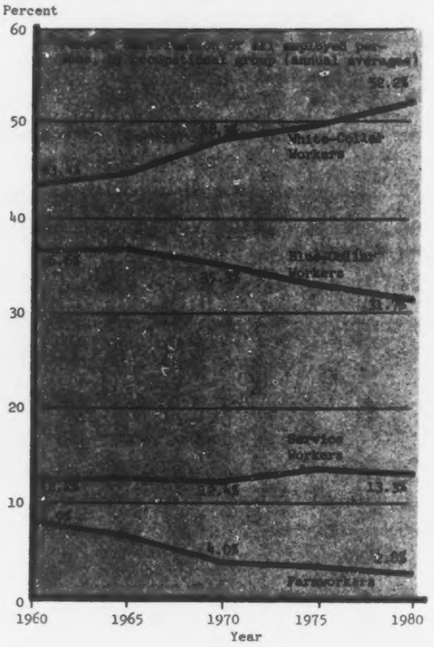
As a result of changes in occupations and industries, the pro-

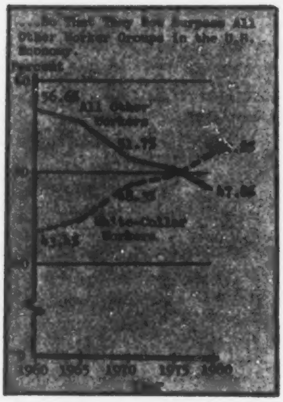
Chart 10. Employment in service-producing industries has risen sharply since the 1960's and far surpasses employment in goods-producing industries.



Source: Bureau of Labor Statistics.

Chart 11. The proportion of white-collar workers . . the labor force has increased steadily over the last 20 years...





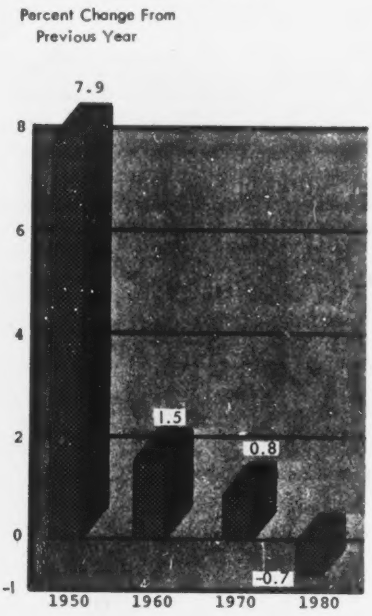
Source: Bureau of Labor Statistics.

portion of white-collar workers has been increasing steadily over the last 20 years (chart 11). Some analysts have even found reason to fear that the further decline of well-paid, blue-collar jobs in manufacturing could eventually lead to a polarization of the labor force. Workers who, for whatever reason, are unprepared to take what are often more highly paid white-collar positions, will in the future have far fewer well-paid blue-collar positions from which to choose. The problem is potentially very serious to the extent that such polarization, if it occurs, may come to reflect the influence of gender or race, as well as shifting occupation and industry patterns. In short, there should be clear concern over a potential "technological gap" that could preclude a substantial part of the population from participating in the most rewarding aspects of the "work revolution" that many foresee.

Productivity

In contrast to the high-tech revolution, which is causing as much optimism as pessimism among observers, the slowdown in productivity growth that economists have noted since the 1950's is universally considered an undesirable change. (See chart 12.) As productivity growth declines in relation to wages, U.S. manufacturing firms are placed at a competitive disadvantage in today's global marketplace. There they must compete against foreign firms that generally have access to a less-expensive labor pool or, as in the case of Japan, that have already automated much of their manufacturing production process. The result has been reflected in a decline in sales for American businesses and a subsequent loss of American jobs. In an effort to increase their competitive standing in the world marketplace, many U.S. firms

Chart 12. The productivity[1] growth rate has been shrinking steadily since the 1950's.



[1] Output per hour of all persons in the private business sector.

Source: Department of Labor, Bureau of Labor Statistics.

have begun to place more emphasis on efficient management, to automate production processes wherever possible, and to stress the importance of continuing research and development. For American workers, the options may be less attractive: Either increase productivity substantially relative to other nations, or accept lower wages.

Since growth in productivity is related to increasing skills of workers, education and training are important to solving the productivity problem. The educational attainment of the civilian labor force rose from 10.9 years of schooling to 12.7 years from 1952 to 1980. (See chart 13.) Nevertheless, a high school diploma may not always represent a fair measure of employability. The United States ranked second among industrial nations in the "measured skill endowments" of its labor force in 1963; by 1975, it had dropped to seventh place. In 1981, when around 10 million persons were unemployed, nearly one million skilled jobs went unfilled.

Three out of four jobs will require some technical training beyond high school by 1990, according to estimates by the Bureau of Labor Statistics. Evidence of growing skill shortages in some critical fields and a decline in mathematical and verbal abilities among high school graduates are of particular concern in view of the occupational changes associated with automation. According to recent tests, one out of five high school graduates in the United States lacks the language and mathematics skills that are necessary to function successfully in society.

Only one-third of this Nation's 17,000 school districts require more than 1 year each of math and science; in Japan 25 percent of *all* class time in grades 7 through 9 is allotted to these subjects, while at the senior high school levels, four math courses and three natural science courses are the norm. Currently, nearly one-quarter of all students in U.S. high schools fail to graduate, compared with 8 percent in Japan and only 2 percent in the Soviet Union. The school dropout rate in the United States is especially high for minority groups, who will make up a growing proportion of new labor force entrants in the coming decades—45 percent among Hispanics, 35 percent among blacks. While simple international comparisons of any statistics should be interpreted with extreme caution, there is, nonetheless, reason for concern about the employment prospects of American youth in our increasingly technologically advanced society and about future U.S. productivity.

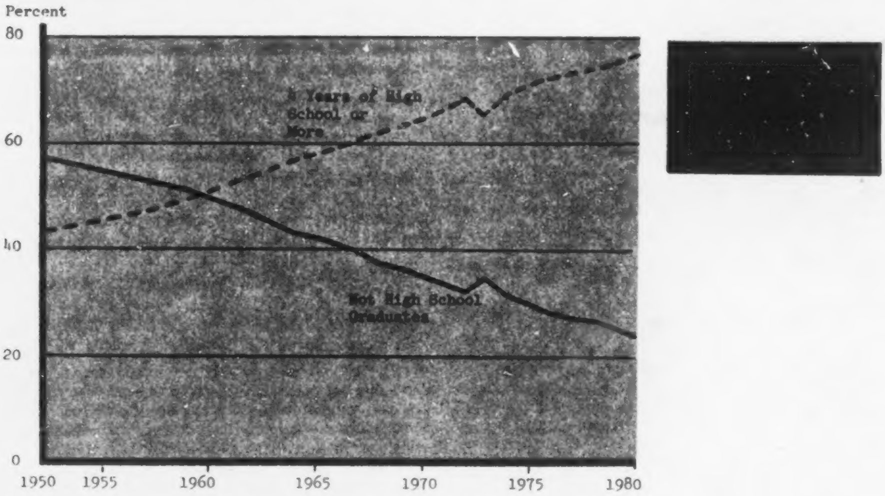
Similar problems may be experienced by some individuals who are already in the labor force, particularly workers in jobs that may be eliminated or greatly changed as a result of technological advancement. For these workers, retraining may be the only solution to an otherwise uncertain future. Education and training are, therefore, central to meeting the changing employment needs of the 1980's and increasing the Nation's productivity growth rate.

Implications for Government Policies and Programs

It is clear that the United States has entered a period of profound change, not only in the characteristics of its worker population but in the jobs that will be available in the 1980's and beyond. Although there is no certainty, the effects of these employment changes may be as personally wrenching to individuals in the short run though as economically beneficial to the Nation in the long run as the Industrial Revolution was in the 19th century.

On the positive side, demographic changes seem to be moving in the direction of a more mature and stable work force. A slower population growth rate during the 1980's should help ease competition for entry-level jobs and reduce the current high unemployment rate among teenagers. Tighter labor markets should benefit especially black and Hispanic youth, who will make up a sizeable proportion of new labor force entrants by the end of the decade, and women, who are expected to continue to enter or reenter the job market at increasing rates. The

Chart 13. Over the last 30 years, educational attainment among members of the civilian labor force* has risen dramatically.



*Data for 1972 forward refer to persons 16 years and over; 18 years and over for prior years.

Source: U.S. Bureau of the Census and Bureau of Labor Statistics.

maturing of the baby-boom generation into prime working ages should also have a positive effect on the economy insofar as productivity growth relates to the possession of a skilled and experienced work force.

Other changes in the 1980's and 1990's also promise economic benefits by increasing the supply of jobs. For example, geographic shifts in population will expand the demand for goods and services in areas where the population is growing. Continued expansion of the service sector, plus the explosive growth in computer and telecommunications fields, advances in robotics, and other developments in high-tech industries, are expected to create many new employment opportunities throughout the remainder of this century.

Nevertheless, these benefits cannot obscure the fact that employment changes of the magnitude predicted for the eighties have a dark side as well. Because many of the new jobs created in this and future decades will require a high level of skill, young workers, and others seeking entry-level positions may find fewer unskilled and semiskilled jobs available and the possibilities for career advancement without special training more limited than in the past. The problems already faced by men and women working in traditional blue-collar occupations whose jobs are being eliminated or drastically altered because of automation, plant closures, or other unforeseen events are, perhaps, even more serious. For these workers, the short-term effects of change, whatever the long-term benefits for society as a whole, can be a personal tragedy.

Thus, some of the greatest challenges for policymakers in all sectors in the 1980's will be: (1) to assist and educate new workers about preparing themselves for many new kinds of jobs, (2) to assist experienced workers to accommodate the immediate imbalances that are being created by swift and far-reaching employment changes, and (3) to help employers adjust to a work force that is changing while at the same time coming to terms with worldwide competitive forces that may require the rapid introduction of automated machinery or some other change in production techniques.

The United States, unlike many western European nations, does not have comprehensive national, State, or local employment policies that can assist in the adjustment process. Rather, there are multiple programs and policies in place, funded and administered by private industry and labor as well as by all levels of government, with varying degrees of interaction and collaboration among them. Thus, a basic question that policymakers must address is whether these various programs and policies should be integrated into a more coherent approach to solving employment problems and how this might be done most effectively, if such a goal is, indeed, desirable.

What should be the respective roles of general government, private industry, labor, education, and other key actors in such a process? Is it the most effective potential policy to permit many of the long-term problems to be remedied without major government intervention, with only short-term employment imbalances given specific attention? Are the policies and programs that are currently in place adequate or are fundamental changes required? Simply stated, what can be done and by what sector to help create more jobs and to prepare people for those jobs?

In answering this last question and as a first step toward the development of comprehensive government policies, existing programs and delivery systems need to be examined to determine whether they can meet the new challenges adequately, whether they might be modified and improved in some way, or whether a substitute of some kind might be better adapted to the employment changes that are taking place. Some key questions that should be addressed follow:

Education

- In view of the expected demand for higher levels of technical skill in future occupations, what improvements need to be made at the elementary and secondary school levels to ensure that young people acquire basic levels of verbal and mathematical skills? For example, what practical steps can schools take to attract and keep teachers of scientific and other critical skills who are also much in demand in private industry?

- How can schools help students to develop the computer skills that will be needed in a technically advanced society? Can private industry assist in this activity, and what incentives may be required to bring about such a partnership effort?

- How can public schools improve their ability to assist non-English-speaking students in acquiring English language fluency? Should this concern become a matter of increased Federal policy intervention or should its responsibility rest at the State or local levels?

- What specific kinds of preventive strategies can be developed to help forestall school dropouts and/or disproportionate youth unemployment, particularly among minority youth who currently experience exceptionally high dropout and unemployment rates? Are there joint public/private ventures that can assist in this effort?

- Can schools improve their ability to assist teenagers in understanding how the labor market works, what job skills are in demand, how to find jobs, and how to be successful on the first job? What changes are necessary in existing labor market information activities to improve the quality of vocational guidance?

- Is there a role for the schools in helping to instill proper work attitudes in young people? How can this be done?

- How can the existing vocational education system be attuned more closely to occupational growth areas and more effectively utilized to meet the training challenges of America's labor force?

- What role can the educational system, especially post-secondary institutions, play in retraining experienced workers who face long-term unemployment due to job displacement?

- What improvements are possible in integrating educational programs with public and private occupational skill training programs, apprenticeship, job search activities, and other employment-related programs? How can such integration be facilitated?

Training

- Should there be publicly funded training/retraining programs, such as title III of the Job Training Partnership Act provides, to serve the needs of technologically displaced workers in auto, steel, and other distressed industries, or should these individuals be expected to obtain and pay for their own training and retraining without government intervention?

- How should the training needs of displaced workers be balanced against the needs of other persons who lack vocational skills and, frequently, basic verbal and mathematical abilities, given the limited public resources available for both tasks?

- How can government-funded training programs, such as the newly enacted Job Training Partnership Act, be integrated most effectively with other training programs offered by private business and public and private schools?

- How effective are government-funded training programs for specific groups? Are there, for example, special strategies required for older workers who are displaced from a job and unable to find another?

Labor Exchange Systems

- How can the quality and quantity of labor market information be increased and the average job seeker be kept better informed about what kinds of occupational skills are most in demand?

- Are there ways to improve occupational forecasting and vocational counseling in order to prevent some worker dislocation problems from occurring?

- How can the current Federal-State Employment Service system work more effectively with public and private training programs? Will the collaborative process required under the new Job Training Partnership Act prove useful in this effort?

- Should the Employment Service continue to serve as a general labor exchange or should it specialize in serving particular groups with special needs such as the economically disadvantaged, youth, older workers, or some other narrowly defined group or groups?

- Is it possible to develop an effective nationwide, computerized network of job openings that can be used easily by a broad range of people and institutions?
- Should publicly funded relocation assistance become an integral part of the services offered to displaced workers by the Employment Service?

Unemployment Insurance

- Should the unemployment insurance (UI) system be transformed into a vehicle for supporting retraining as well as providing income replacement during job search given the likelihood of increased numbers of displaced workers who will never be able to return to the same or even similar jobs in declining industries? Several European nations (notably Germany) offer this kind of program, and some recent proposals have emerged that call for the adoption of a similar approach in the United States. What are the merits of these proposals and what are their implications for the UI system in terms of funding, benefit coverage, administration, etc.?
- Are current laws and regulations regarding unemployment insurance coverage, duration and size of benefits, extended benefit triggering mechanisms, and other program requirements attuned to our changing labor market? Are there modifications that need to be made in any of these elements?
- Should the Government continue to offer special unemployment compensation programs for groups of workers who may face particularly high risks of unemployment due to national policies (e.g., the Trade Adjustment Assistance program for workers adversely affected by trade imbalances) or natural disasters?
- Is the current unemployment insurance financing system adequate, given the prevalence of severe regional imbalances in unemployment rates?

Welfare/Workfare

- What lessons have been learned from the Work Incentive (WIN) program, workfare experiments, and other training and job-related efforts for welfare recipients that could be applied under a revised welfare system?
- What kinds of policies should be adopted to encourage greater transition of benefit recipients into unsubsidized jobs?
- What kinds of assistance policies best serve the working poor?

Pension and Retirement Policies

- What are the effects of government pension policies on the employment opportunities for older Americans and their decisions to stay in or leave the work force? Does the permissibility of private sector mandatory retirement at age 70, along with government regulations and policy on Social Security earned income ceilings, result in involuntary idleness among older Americans who wish to continue working? What changes are needed in these policies and programs as we anticipate a further aging of the work force?
- What changes could private industry make both in their pension and retirement policies and their human resources practices to maximize job opportunities for all workers, without regard to age considerations?

Wage Policies

- What is known about the effects of wage laws on employment? Are laws governing minimum wages and prevailing wage rate guarantees helpful or harmful for the economy as a whole, for workers in general, or for specific groups of workers?
- Are wage-related tax credit programs such as the Targeted Jobs Tax Credit program useful in moving welfare or training program clients into unsubsidized jobs?

Trade and Immigration Policies

- What trade and immigration policies are most beneficial for the U.S. economy and for workers in both the short and the long term? Are protectionist policies helpful or harmful in maintaining economic prosperity?
- How can employment and training programs be managed so that they help compensate for any economic imbalances that result from decisions about trade or immigration?

Tax Policies

- How effective are tax credits as a means of bringing about private sector involvement in employment and training programs (e.g., Targeted Jobs Tax Credit) and in creating new job opportunities (e.g., Urban Enterprise Zones)? Is the tax system the proper vehicle for providing wage subsidies or are there other, more direct devices that might be preferable?
- Are there additional tax credit plans that could be considered as a means of securing private sector involvement in training and promoting the growth of productivity through more private sector research and development, capital investment, and human resource development? What are the relative costs and benefits of these plans?

Alternative Work Schedules

- How helpful are flexitime, job sharing, permanent part-time, and other alternative work schedules in promoting greater employment opportunities?
- Are there particular groups such as older workers and working mothers who can benefit especially from these

flexible work schedules and should their needs become the basis for promoting greater use of alternative work schedules in the public and private sectors?

These questions are not new. Indeed, employment policy analysts have been grappling with many of these same issues for nearly 25 years. However, the Commission believes that new answers to these basic questions must be addressed by the Nation as it adjusts to the changing fundamental labor market conditions of the 1980's and 1990's. Over the last year, the Commission looked at several of these critical issues in considerable detail (see the projects listing that follows), and it will be reporting to the President and the Congress on the results of its examinations periodically throughout the coming year.

If this is truly the beginning of a "work revolution," as many experts believe, it is important that employment policies be devised that will accommodate the expected changes. The Job Training Partnership Act of 1982 established a new public-private partnership in the development and administration of job training programs. This spirit of cooperation is even more urgently needed as the Nation prepares to meet the employment challenges that await throughout the remainder of this century.

Part II
Commission Activities, October 1981 Through December 1982, and Plans for 1983

Since October 1981 and the publication of the *Seventh Annual Report*, the Commission has engaged in a variety of research and other policy-relevant activities in the following major areas: Enactment and implementation of the Job Training Partnership Act, including undertaking a major advisory role in the development of program performance standards; labor market problems of Hispanics, older Americans, and displaced workers; and the employment needs of business. The Commission also sought to identify major employment policy issues of the 1980's in a researchers' conference held in April 1982, and began preliminary work on the development of a project to help promote comprehensive State and local employment policies.

This section of the report briefly describes completed and ongoing projects and presents the proposed work agenda for 1983. Appendix A to this part identifies changes in the Commission membership and staff that occurred during the 15 months covered by this report, as well as persons who have served on various project advisory panels. Appendix B contains the legally mandated Commission comments on published reports of the National Advisory Council on Vocational Education. A full listing of Commission reports and books is presented in the last page of this volume.

Job Training Partnership Act

Much staff time during 1982 was allocated to activities that supported the passage of the Job Training Partnership Act of 1982, which replaced the expiring Comprehensive Employment and Training Act (CETA), originally enacted in 1973. Chairman Kenneth M. Smith testified on the proposed legislation before members of the Senate Subcommittee on Employment and Productivity and the House Subcommittee on Employment Opportunities in March 1982. The Department of Labor and members of the House and Senate authorizing committees called upon Commission staff many times during the year to provide information, assess specific program proposals, comment on draft bills, and otherwise assist in the enactment process. Among the staff papers prepared at the request of Congress were a review of the efficacy of work experience activities and an analysis of the allowance and stipend issue.

Authorization for the National Commission for Employment Policy appears in title IV-F of the new Act. As part of its continuing role in the development of employment policy, the Commission was assigned a major responsibility for the development of program performance standards.

Performance Standards

The Job Training Partnership Act of 1982 establishes a strong, performance-based employment and training system upon which funding and administrative decisions are made. The Act focuses attention on the "return on the investment" of Federal funds in a national employment and training system. Under the Act, the National Commission for Employment Policy is mandated to advise the Secretary of Labor in the development of performance standards and in the establishment of parameters for variations in the standards; the law also requires the Commission to evaluate the impact of performance standards on the selection of clients and services and the cost of services.

In meeting these mandates, the Commission, through its staff, has become an active participant in the Department of Labor's Performance Standards Advisory Committee and is providing continuous advice and guidance both formally and informally, throughout the development process. In addition, in November 1982, the staff hosted a meeting of leading evaluators and researchers in the field to identify the key short-term and long-term evaluation issues raised by the performance standards and other program changes required by the Act. Seven short-term and four long-term issues related to performance standards have been identified and will be evaluated.

In a departure from past practice, all of the short-term issues are intended to provide critical information to practitioners about the impact of the statutory changes; these will, therefore, be addressed by the early fall of 1983, i.e., in time to have an impact on local planning for the first program year that begins on July 1, 1984. The long-term issues, including an in-depth evaluation of the impact of performance standards on the selection of clients and services and the cost of services will be completed by October 1986.

In undertaking these projects, the Commission plans to work closely with Departmental and Congressional staff as it fulfills its statutory obligations.

JTPA Implementation

As part of its activities related to the implementation of the new Job Training Partnership Act, the Commission is monitoring the 12-month transition process as program sponsors close out CETA activities and prepare to begin administering JTPA activities on October 1, 1983. A short-term (1 month) research contract, to be completed by December 31, 1982, seeks to identify States where transitional activities have already begun, locations where significant program changes are expected to occur, and the types of transition-related issues and problems that are likely to surface. The information gathered from implementation activities.

A related project involves the formation of a Practitioners Task Force, which will consist of 15 members appointed by the Commission's Chairman and will be representative of a variety of organizations directly involved in employment and training activities (Private Industry Councils, States, local governments, industry-based economic development programs, organized labor, vocational and postsecondary education, local school districts, Job Service, apprenticeship, and community organizations). It is anticipated that the committee would meet four times per year for the 2 years of its existence and would provide advice and guidance to the Commission, help disseminate Commission findings and recommendations to program practitioners, and assist the Commission in its efforts to link national employment policy with the development of State and local employment policy.

State and Local Model Employment and Training Systems

Comprehensive employment and training systems, encompassing all related program areas, was an original goal of the CETA legislation. JTPA offers State and local governments and the private sector more discretion and responsibility in the organization and management of employment and training programs, but comprehensive policies remain an important aim of the new legislation as well.

The Commission began exploratory work on the development of model projects that would foster the development of State and local employment policies in the summer of 1982. An advisory committee representing State and local governments, researchers, and private foundations met in Washington, D.C., on June 29, 1982, to discuss the feasibility and possible content of such demonstration projects. (See the listing in Appendix A.) No final decision was made on whether to go forward with this project at this time, and additional exploratory work is being conducted and will continue in 1983.

Hispanic-Americans in the Labor Force

The Commission began an inquiry into the labor market position of Hispanic-Americans in 1981 and completed its work on the project in 1982. To obtain its findings, the Commission reviewed existing literature, sponsored new empirical research, hosted conferences on research and policy (February 4-5 and March 25-26, 1982), and interviewed members of national Hispanic organizations, and staff members of relevant executive departments and Congressional committees. An advisory panel consisting of representatives from business, universities, and the education and training community assisted in the effort (see Appendix A).

The Commission issued a combined policy statement and staff report in September 1982 in a volume entitled *Hispanics and Jobs: Barriers to Progress*. Major findings from the research indicate that Hispanics, who are a sizable and growing part of the U.S. population, fare almost as badly as blacks in the labor market in terms of unemployment and wage rates and experience school dropout rates that exceed those for both blacks and whites. Although particular subgroups of Hispanics (i.e., Mexican-Americans, Cuban-Americans, Puerto Ricans, and Central or South Americans) have somewhat different labor market problems, the chief barriers to progress in the job market are the same for all groups, namely, lack of proficiency in English, low levels of formal schooling, and discrimination.

Commissioner Roberto Cambo, who was appointed to the Commission in 1981, was the liaison to the Commissioners and participated in the development of these findings and the issuance of the final report. His efforts continued the work begun by former Commissioner Pedro Ruiz Garza.

National Employment Policy and Older Americans

The Commission began a comprehensive examination of the labor market problems of older Americans and national employment policies that affect them in 1982. The project focuses on two broad policy questions: (1) What levels of participation in the labor market, earnings, and employment for older Americans are appropriate goals for employment and training policy? and (2) What programs and policies, if any, would be most effective in reaching these goals?

Contracted research, funded jointly by the Commission and the Employment and Training Administration of the Department of Labor, is analyzing: participation in and the effectiveness of employment and training programs for older workers; the cost to employers and the employment consequences of certain changes in ERISA and of shifting health care costs of workers over 65 from medicare to employers; factors that influence the availability of part-time jobs for older Americans; the labor market experiences of older Americans who are women or members of minority groups; the effectiveness of innovative employment practices that contribute to increased opportunities for employment of older Americans in the private sector and the effect of government policy on their establishment; the labor market behavior of older workers displaced from their jobs; the relationship between worker productivity and age; and the effect of several specific changes in Social Security on retirement behavior.

Staff research includes: an analysis of the effects of retirement policy on older Americans' participation in voluntary activities; an examination of possible age discrimination faced by older workers who change jobs; and an analysis of the increase in women's lifetime labor force participation on the Social Security system.

Preliminary research results will be presented to an audience of policymakers, researchers, and representatives of interest groups at a conference in Washington, D.C., in early 1983. A staff report will synthesize research analyses on employment and training programs for older Americans, an analysis of their employment opportunities and labor force participation, and their earnings and income.

Commissioner Paul Locigno has been an active participant in all phases of this project.

Displaced Workers

At its September 1982 meeting, the Commission requested the staff to develop a project that focused on the employment needs of displaced workers. Norma Pace was designated as the Commission liaison.

The project proposes to examine the following factual and policy questions: Is it possible to objectively identify individuals as displaced workers? How do income maintenance and retraining programs affect such workers? What is the outlook for displacement in particular industries, and how should firms, unions, educational institutions, State and local governments, and Federal policymakers react to the problem? Are there especially promising new approaches or modifications to existing programs such as unemployment insurance that will aid the displaced?

Project staff will collect and evaluate descriptive and policy-oriented material, prepare an analysis of options, and consider what long-term research might usefully be funded to supplement the ongoing efforts of other concerned agencies and departments. Work on this project will go on through most of 1983 and may continue into 1984.

Detroit Field Visits

As a first step in defining the issues surrounding worker dislocation, the Commission visited a number of training sites in Michigan on November 30, 1982, and held a full day of public hearings on December 1, 1982, in Detroit, Michigan.

The training sites that were visited by Commissioners and staff included a community resource center that specializes in assisting laid-off workers (Downriver Community Conference in Wyandotte), a joint union-management training effort (UAW/Ford National Development and Training Center in Dearborn), a community college training facility (training in the operation of robots at Macomb Community College in Warren), and a corporate training facility operating with the assistance of Federal funds (Chrysler Learning, Inc., in Highland Park). Each site offered unique examples of local initiative and involvement in meeting the needs of displaced workers.

Witnesses at the December 1 public hearing described the plight of unemployed workers in Michigan and suggested a variety of policy responses. Governor William G. Milliken and Mayor Coleman Young of Detroit were the lead-off witnesses. Others included county officials, State agency officials, business and union representatives, and educators. Observations on the displaced worker problem and suggestions for future study from several noted Michigan employment researchers concluded the formal hearing.

Early in 1983, Commission staff will review the findings and recommendations from the site visits and hearing in the process of developing a final work plan for the Displaced Workers Project that will be undertaken by the Commission.

Needs of Employers

Most research on employment issues focuses on employees; very little of the available literature considers the needs of employers. To improve our knowledge of what employers require and what kinds of employment and training programs are most helpful, the Commission in 1982 instructed the staff to develop a project that would address these issues. Formal research and staff field work constitute the major sources of information in this effort.

The project will examine the experiences of successful public/private partnerships in education and in employment and training. Its aim is to develop a core body of information that will help inform policymakers at national, State, and local levels about ways in which policies might be oriented more successfully toward the needs of employers and assist State and local program administrators and managers in designing and managing their programs.

Two research contracts were awarded in October 1982 to undertake special studies of the employer survey data base developed as part of the Employment Opportunities Pilot Project, previously administered by the Department of Labor. Staff fieldwork, including site visits and telephone interviews, is continuing. A seminar with other research groups and relevant organizations is planned for the Spring of 1983.

Michael Caver and D. Quinn Mills are serving as Commission liaisons for this project, and a technical advisory committee has met to discuss planned activities (see Appendix A).

Invitational Conference on Employment Policy Analysis

The Commission and the W.E. Upjohn Institute cosponsored an invitational conference to examine employment policy issues for the 1980's on April 28 and 29, 1982. The purposes of the conference were to provide a forum for the discussion of employment issues and to help the Commission develop its own research agenda.

During the discussion, researchable issues were developed for each of the following topic areas: (1) the role of employment policy in the Nation's economy, (2) changes in industries and occupations, (3) training and maintaining a skilled work force, (4) improving employment opportunities for the disadvantaged, (5) aging of the work force, and (6) coping with regional growth and decline. In addition, several suggestions, which cut across the various topic areas, called for work to be done on aspects of the collective bargaining process.

Commission Agenda for 1983

The Commission plans to continue in 1983 the major ongoing projects described above. Staff will complete research for the older Americans, displaced workers, and employment needs of business projects, with policy recommendations and staff reports to be issued later in the year or early in 1984. In addition, the Commission will continue activities related to the implementation of the Job Training Partnership Act and, in particular, will further advise the Secretary of Labor on the development and usage of performance standards under the new law. Studies related to a number of the previously developed research and evaluation issues for JTPA should be started during the year and some of the short-term projects are scheduled for completion by October 1983.

Throughout much of 1982, the Commission was asked by congressional and executive staff to review policy and program proposals, suggest new methods for meeting employment needs, and otherwise assist in a policy development process. Often these requests had a short turnaround time and required intensive efforts by one or more staff to prepare a response. It is expected that these types of requests will continue in 1983 and perhaps even increase, so that a substantial proportion of staff time will be devoted to activities that will not appear under particular project headings.

Appendix A

Commission Members, Staff, and Advisory Panels, 1982

Commission Membership

Ten new public members were appointed to the Commission by President Reagan late in 1981. Kenneth M. Smith, President and Chief Executive Officer of the International Management and Development Group, Ltd., was appointed to the Commission in December 1981 and named as chairman. Other new public members include:

Roberto Cambo, President, Rocam Produce Company
Michael D. Caver, Associate, Heidrick and Struggles, Inc.
Jack A. Gertz, Public Affairs and Media Relations Manager, AT&T, Washington, D.C.
Paul R. Locigno, Research Director, Ohio Conference of Teamsters
Edward D. Miller, President and Chief Executive Officer, Future Business Leaders of America-Phi Beta Lambda and Chairman, National Advisory Council on Vocational Education
D. Quinn Mills, Professor of Business Administration, Harvard University
Norma Pace, Senior Vice President, American Paper Institute
Roderick R. Paige, Professor of Education, Texas Southern University
Kenneth O. Stout, Executive Director, Arctic Enterprises, Inc.

Federal members on the Commission include the Secretary of Labor, Raymond J. Donovan; Secretary of Health and Human Services, Richard J. Schweiker; Secretary of Education, Terrel H. Bell; Administrator of Veterans Affairs in the Veterans Administration, Harry N. Walters; and Chairman of the Equal Opportunity Commission, Clarence Thomas, who replaced the previously acting Chairman, J. Clay Smith.

Commission Staff

Patricia W. Hogue was appointed to the post of Commission Staff Director by Chairman Kenneth M. Smith in March 1982. Previously, Ms. Hogue had served as the Commission's Director of Legislative Analysis. Dr. Daniel H. Saks, who served as Staff Director for 2 years, became a Brookings Institution Fellow in January 1982. Dr. Ralph E. Smith, Deputy Director, acted as the Director until the appointment of Ms. Hogue in March.

For some years, the Commission has supplemented its permanent staff with visiting experts. In October 1982, three visitors joined the staff: Ann Donohue from the National Governors' Association, an expert on unemployment insurance who is participating in a major Commission project on displaced workers; Gary Moore, from the Arizona State Office of Economic Planning and Development, who will lead a project on the development of State and local employment policy; and John Wallace, Director of Human Services, San Mateo County (Ca.) Prime Sponsor, who is directing the Commission's work in fulfilling the congressionally mandated role as an advisor to the Secretary of Labor on the development and implementation of performance standards under the Job Training Partnership Act of 1982.

Four visitors who had participated in major project activities in 1982 completed their assignments and left the staff during the year. They included: Howard S. Bloom, an economist from Harvard University; Virgulino L. Duarte, from SER-Jobs for Progress; Michael McKee, from the Council of Economic Advisers; and Ronald S. Warren, Jr., an economist from the University of Virginia. Patricia D. Brenner, a staff associate with the Commission for 3 years, joined the staff of the International Monetary Fund in July 1982. Laura Dietrich, assistant director for legislative analysis, left the staff in August to join the U.S. International Development Cooperation Agency. In addition, in October, Ralph E. Smith, Deputy Director of NCEP, began a leave of absence from the staff to pursue economic studies as a senior research fellow at the Australian National University in Canberra, Australia.

Two research assistants also joined the staff during the year: Billy Dickens, a Ph.D candidate in economics at American University, and Brenda Lester, a volunteer with special expertise in older worker programs who is assisting with various aspects of the project on national employment policy and older Americans. Robert Schmid, a research assistant specializing in legislative affairs who had been with the Commission for 1½ years, left the staff in May 1982 after graduating with a degree in economics from Georgetown University. David Officer, a summer intern, returned to Cornell University in September 1982.

Anita L. Smith and Shirley A. Percy are new additions to the Commission's secretarial staff.

During 1982, Commission staff included:

Patricia W. Hogue, Director
Ralph E. Smith, Deputy Director

Research and Policy Analysts:
Robert G. Ainsworth
Stephen E. Baldwin
Howard S. Bloom (visiting from Harvard University)
Patricia D. Brenner
Everett E. Crawford

Laura Dietrich
Ann E. Donohue (visiting from the National Governors' Association)
Virgulino L. Duarte (visiting from SER-Jobs for Progress)
Michael McKee (visiting from the Council of Economic Advisers)
Gary J. Moore (visiting from the Arizona State Office of Economic Planning and Development)
Janet W. Johnston
Carol L. Jusenius
Steven H. Sandell
John W. Wallace (visiting from San Mateo (California) County Prime Sponsor)
Ronald S. Warren, Jr. (visiting from the University of Virginia)

Administrative Staff:
Sara B. Toye, Assistant Director for Administration
Barbara Z. MacNeill, Administrative Officer
Laura von Behren, Publications and Conference Coordinator
Velada G. Waller, Secretary to the Director

Secretaries:
Madeline Hachey
Deborah Hackett
Shirley A. Percy
Anita L. Smith

Research Assistants and Interns:
Robert Schmid
David Officer
Billy R. Dickens
Brenda T. Lester

Commission Advisory Panels

In planning projects and conducting research, the Commission often seeks the advice and guidance of experts in particular subject areas. These experts may include academicians, educators, business representatives, labor leaders, community groups, and others with special expertise. Members of the various advisory panels, who assisted the Commission in 1982, are listed below.

With great regret, the Commission reports that Dr. E. Earl Wright, Director of the W.E. Upjohn Institute for Employment Research, who ably served as a member of several advisory panels and who actively supported other Commission activities, died in an automobile accident during the year.

Hispanic Advisory Committee

Roberto Cambo,
Commissioner
President, Rocam Produce Company, Inc.
Miami, Florida
(Chairman of the Committee, 1/82-completion)

Rita De Martino
District Manager
Public Relations Department
American Telephone and Telegraph

Jose Pico, President
P&L Meat Processors Corp.
Hialeah, Florida

Cordelia Reimers
Associate Professor
Department of Economics
Hunter College

Pedro Ruiz Garza
President
SER-Jobs for Progress
(Chairman of the Committee 10/80-10/81

Roy Escarcega
Senior Vice President
The East Los Angeles Community Union

Diana Schacht
Legislative Assistant to Resident Commissioner of Puerto Rico
Baltasar Corrada

Marta Tienda
Associate Professor
Department of Rural Sociology
University of Wisconsin-Madison

Fred Romero
Deputy Administrator
Office of Strategic Policy and Planning Development
Employment and Training Administration
U.S. Department of Labor

Raul Moncarz, Professor
Economics Department
Florida International University

Velma Montoya
Assistant Director for Strategy
Office of Policy Development
The White House

State and Local Model Employment and Training Systems Advisory Panel

Kenneth M. Smith,
Chairman
National Commission for Employment Policy

Bernard Anderson, Director
Social Sciences Division
The Rockefeller Foundation

Roy James, Assistant to the Governor for Economic Development
Office of the Governor of Missouri

William McLaughlin, Mayor
Wilmington, Delaware

Susan Golding
City Councilwoman
San Diego City Council

George Israel, Mayor
Macon, Georgia

Earl Baker, Chairman
Chester County Commissioners
Westchester, Pennsylvania

Robert Taggart, Director
Youth Knowledge Development Project

George Autry, MDC, Inc.

Needs of Employers Project Technical Advisory Committee

D. Quinn Mills, Chairman
Professor of Business Administration
Harvard University

Michael D. Caver,
Commission Liaison and Ex-Officio Member
Heidrick and Struggles, Inc.

Carl Van Horn
Eagleton Institute of Politics
Rutgers University

Harvey S. Lederman
Executive Director
Heller Institute for Small Business

James G. Parkel
IBM Director of Employment

Katharine G. Abraham
Assistant Professor
Sloan School of Management
Massachusetts Institute of Technology

Appendix B

Comments of the National Commission for Employment Policy on the Report of the National Advisory Council on Vocational Education

The National Commission for Employment Policy is required to comment annually on the reports of the National Advisory Council on Vocational Education under provisions of the Comprehensive Employment and Training Act Amendments of 1978 (P.L. 95-524, title V). The Commission's review of these documents is chronological, covering those issued since the *Seventh Annual Report*.

1. October 1981, "The Policy Statement on Reauthorization of the Vocational Education Act," makes the following major points: (1) Federal dollars should be targeted to areas where State and local resources are inadequate or unavailable to do the job; (2) a separate allocation should be made to major city school districts to aid in serving disadvantaged students; (3) incentive funds should be available to reward innovative approaches; (4) apprenticeship programs should be expanded; (5) funds appropriated for purchase of modern equipment and other innovative ways to obtain student access to up-to-date equipment should be explored, such as on-site use of business facilities during slack hours; (6) States should be given more discretion in how they use funds to achieve targeted purposes, but Federal money should not be used for basic ongoing programs; (7) the emphasis on sex equity and elimination of sex-role stereotyping of occupations should be continued; (8) expanded business and labor participation should be fostered at all levels in the advisory council structure. The thrust of these points is in accord with the Commission's September 1981 report, *The Federal Role in Vocational Education*, and its January 1981 report, *Increasing the Earnings of Disadvantaged Women*.

2. November 1981, "Survey of the Impact of the Education Department's Compliance Reviews of State Plans." The council concluded that the process does not completely fulfill the law's mandate; there seems to be no link between the review and improvement of vocational programs. The Council recommended that quality reviews should be expanded to functional areas, e.g., special needs populations, and should provide technical assistance to augment strengths and reduce weaknesses in program operations. This is consistent with findings by the National Center for Research in Vocational Education, and research on coordinated vocational and other programs funded by the Commission.

3. December 1981, "Briefing Paper on the Vocational Education Study," which was completed by the National Institute of Education in October 1981. NACVE's interpretations of the study implications include: the need for more precise and internally consistent authorization language; congressional intent should be made explicit; the need for consideration of vocational education's role in overall human resource development strategies; and that there is little evidence in the study to support the use of block grants as the Federal funding mechanism for vocational education. The Commission has not officially reviewed the study, and is grateful to the Council for its evaluation.

4. February 1982, Statement on "The Need for a Continuing Strong Federal Partnership Role in Vocational Education." The Council believes that without such a Federal role, "it is difficult for diversified local jurisdictions to plan programs which respond to long-term skill development needs of our economy." The Commission made essentially the same points in its September 1981 recommendation that the goal should be improving the "effectiveness of the total national training effort."

5. June 1982, *1981 Annual Report*. This report reviewed the reports issued during 1981, including the Council's comments on the reports of the National Commission for Employment Policy. It also lists the initial 16 new council members appointed in April 1982. (The remaining five were appointed later in 1982.) The new Chairman of the Council is Edward D. Miller, who also sits as the Council's representative on the National Commission for Employment Policy.

6. Finally, in September 1982, Council Member Dr. Vernon Broussard presented a statement to the National Commission on Excellence in Education at its hearings in Denver, Colorado. The National Council statement stresses the central role of vocational education in human resource development and national economic recovery. An important aspect of vocational education's contribution is its experience in using cooperative experiential learning. This is seen as increasingly important in an era in which much retraining will be required of persons already in the work force. The Commission's work on the retraining of displaced workers as part of policy responses to structural change will be aided by viewing vocational education in this light.

7. The Commission intends to consider the future Federal role in vocational education in the context of overall employ-

ment policy, in light of the fundamental changes in the labor market which are highlighted elsewhere in this volume.

Although the memberships of both the NCEP and NACVE have changed since the Commission's last annual report, the cross-representation between the two bodies and continued communication at the staff level have allowed the work of each to go forward in conjunction with the other. The relationship has thus proved to be both durable and valuable.

A Tribute to Dr. Eli Ginzberg

> The easing of human labor by technology, a process that began in prehistory, is entering a new stage. The acceleration in the pace of technological innovation inaugurated by the Industrial Revolution has until recently resulted mainly in the displacement of human muscle power from the tasks of production. The current revolution in computer technology is causing an equally momentus social change: the expansion of information gathering and information processing as computers extend the reach of the human brain.
>
> *Scientific American*
> September 1982

With this statement, Dr. Eli Ginzberg began the introduction of a *Scientific American* issue devoted exclusively to an examination of the latest stage of the continuing Industrial Revolution. Dr. Ginzberg, Director of Conservation of Human Resources at Columbia University and Chairman of the National Commission for Employment Policy from 1974 through 1981, has long been a leader in the employment policy field. The members and staff of the Commission wish to acknowledge his outstanding contributions to the field and to express their appreciation for his leadership during the years that he served as chairman.

Acknowledgements

This report was written by Dr. Janet Johnston, with assistance from other members of the Commission staff. Michael J. Landini, Jr., of the Department of Labor's Employment and Training Administration, prepared the graphic illustrations, and Emily Dean, from the Department of Labor's Office of Information and Public Affairs, designed the cover. Anita Smith of the Commission patiently and efficiently typed each successive draft. Laura von Behren, Publications and Conference Coordinator, supervised the publications process.

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Proceedings of a Conference on Public Service Employment, Special Report No. 1, May 1975 (NTIS Accession No.: PB 291135)*

Manpower Program Coordination, Special Report No. 2, October 1975 (NTIS Accession No.: PB 291217)*

Recent European Manpower Policy Initiatives, Special Report No. 3, November 1975 (NTIS Accession No.: PB 291242)*

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National Commission for Employment Policy: The Federal Role in Vocational Education, Report No. 12, September 1981. (ERIC No.: 208248)**

National Commission for Employment Policy, Seventh Annual Report: The Federal Interest in Employment and Training, Report No. 13, October 1981.*

Hispanics and Jobs: Barriers to Progress, Report No. 14, September 1982.* (NTIS Accession No. PB 82-255720)*

The Work Revolution: Eighth Annual Report of the National Commission for Employment Policy, Report No. 15, December 1982.

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Books Published for the National Commission for Employment Policy

The following books may be obtained from the publishers at the addresses indicated below:

From School to Work: Improving the Transition, National Commission for Employment Policy, Suite 300, 1522 K Street, NW, Washington, D.C. 20005.

Employability, Employment and Income: A Reassessment of Manpower Policy, Olympus Publishing Company, Salt Lake City, UT 84105, September 1976.

Jobs for Americans, Prentice-Hall, Inc., Englewood Cliffs, NJ 07632, October 1976.

Youth Employment and Public Policy, Prentice-Hall, Inc., Englewood Cliffs, NJ 07632, 1980.

Public Service Employment: A Field Evaluation, The Brookings Institution, Washington, D.C. 20036, 1981.

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Mr. WALGREN. We will go to Mr. Ramsey at this point, and then we will come back to you.

Mr. Ramsey, welcome to the committee.

[The biographical sketch of Mr. Ramsey follows:]

Name:	Lucien P. (Duke) Ramsey
Address:	212 Melvin Drive Pittsburgh, Pennsylvania 15236
Service Record:	June, 1962 - October, 1966. Active duty, United States Marine Corps.
Education:	B.A., August, 1970, Point Park College, Pittsburgh, Pennsylvania Major: Behavioral Sciences Duquesne University, graduate work in Sociology Shippensburg State College, graduate work in Counseling
Experience:	Commonwealth of Pennsylvania, Office of Vocational Rehabilitation March, 1974 to Present: Rehabilitation Placement Specialist. Responsibility for direct placement of disabled individuals upon referral from, and in consultation with, other rehabilitation counselors. Primary emphasis working with severely disabled. Also functions as the lead counselor for the placement unit. May, 1973 to March, 1974: Disability Adjudicator. Adjudicates claims for disability benefits filed under the Federal Social Security Act on basis of provisions of the Act and on pertinent regulations and standards. Commonwealth of Pennsylvania, Office of Employment Security February, 1972 to May, 1973: Employment Counselor Analyze and evaluate the placement difficulties of physically, emotionally or mentally handicapped job applicants; counsel those clients encountering job choice, job change and job adjustment problems, through face-to-face counseling and/or group counseling sessions. February, 1971 to February, 1972: Employment Interviewer As a job developer, has primary responsibility for job placement activities and employer relations for disabled clients.

Special Projects: Co-founder and now President of "The Pittsburgh Alliance for Employment of the Handicapped". This all volunteer non-profit organization is a consortium of over 60 rehabilitation agencies; the primary purpose is to facilitate and coordinate the referral of qualified handicapped individuals into employment situations.

Served a term of office as Chairman, "The Pittsburgh Committee on Employment of the Handicapped."

Co-authored the Skill Training and Enhanced Placement (STEP) Grant - Rehabilitation Services and Facilities, Innovation and Expansion Grant #13-626. (1976)

Authored the CETA Grant for Pittsburgh Alliance for Employment of the Handicapped. (1980)

Chairman, Mayor's Task Force on Employment of the Handicapped - Pittsburgh, PA

Professional Organizations:
Board Member, National Rehabilitation Association, Job Placement Division
Member, Pennsylvania Rehabilitation Association
Member, Pittsburgh Personnel Association
Vice President, Open Doors for the Handicapped, Mon Yough Chapter

Mr. **Ramsey**. Thank you, Mr. Chairman. I appreciate the opportunity to address the subcommittee on this important issue.

Amy Jones, Sam Smith, Walt Tanner, and Donna Williams, all fictitious names, are all severely handicapped individuals who firmly believe that high technology has impacted quite favorably on the handicapped population. They not only are alive today because of technology but, in spite of their very severe handicaps, they are also competitively employed, due in large part to advances in high technology.

One individual who, because of his cerebral palsy, cannot communicate well, now carries on normal conversation with coworkers, friends, and family through the use of a programable talking computer. By just pressing two pads, a complete sentence is spoken by the computer. This portable computer also can answer his telephone, call for help in emergency, and completely control his environment at home—lights, TV, et cetera.

Another individual who is blind works as a switchboard operator by using a light sensor that tells her which line the incoming call is on.

The list of people who are now working because of advances in technology could go on and on, but suffice it to say, technological advances have been of tremendous benefit to this Nation's handicapped population.

What I would like to accomplish today are two things, and these are taken from the objective of these hearings: One, to demonstrate how technology is leading to changes in the handicapped community, specifically the work force and environment; two, to recommend specific Government action which will help with the adjustment of the handicpaped work force to technology.

As to No. 1, how technology is leading to changes in the handicapped work force and their environment, four points are important to consider:

One, more handicapped are alive because of high technology.

Two, more handicapped are trained or retrained with the help of high technology.

Three, more handicapped are living independent lives due to technology.

Four, more handicapped are employed competitively due to high technology.

The technology is available today for most handicapped people to become employable. No more can we way that if only someone would invent those or design that, then my client would be employable. Bioengineers are constantly inventing and designing aids for the handicapped so that they become independent functioning members of society. But that isn't enough. You can have all the high technology in the world available for the handicapped person, but you also need two other very important elements in order to successfully rehabilitate a severally handicapped individual.

One, there must be an improvement in the economy in order for there to be jobs open. We can't afford, both monetarily and psychologically, to have trained, skilled, employable handicapped workers with little or no job prospects on the horizon. It is very distressing to guide and counsel a handicapped individual along the road to rehabilitation, only to be frustrated at the critical point in his rehabilitation—no place to apply for work because "we are not hiring, we are in lay-off status." If I have heard that phrase once, I have heard it a thousand times. There have to be jobs for the handicapped applicant to apply for.

Two, the second element that is needed is an incentive for the employer to be willing to consider hiring a severely handicapped person. You can have all the good intentions in the world, but in order for most employers to seriously considering hiring the severely handicapped person, there have to be incentives. Generally, when one speaks of incentives, it boils down to money. I have found over the years that if the employer has several relatively equal, in skill level, potential employees to chose from, he would look real hard at my referral of a handicapped individual if there was on-the-job training moneys available, or other financial incentives for him. Quite often, that was the deciding factor.

Just last week this exact situation presented itself again. The employer narrowed the field down to two individuals, one severely handicapped and the other not. I offered OJT training moneys to the employer and the handicapped individual was hired. There was no question in the employer's mind that the OJT money made the difference.

Technology is developing aids for the severely handicapped population almost faster than we can talk about them.

Now, what can the Government do which will ease the adjustment of the handicapped work force on the work place through technology?

In addition to helping the Nation's employers to accommodate the handicapped worker through the continued use of financial incentives, for example, the targeted jobs tax credit program and on-the-job training moneys, more emphasis needs to be put on research and development for rehabilitation engineering and technology.

Recently a study was completed by the Professional Development Council of the National Rehabilitation Counseling Association to identify major research needs in rehabilitation. Of 12 research categories, the third greatest need for research and development was rehabilitation engineering and technology. This category contained areas related to the application of advance technology in medical, social, and psychological areas to enhance rehabilitation efforts and to solve the functional problems of handicapped people.

Among the research and development topics mentioned were communication devices, engineering applications for independent living and mobility, determination of the most effective barrier-free design criteria, and transportation systems to serve people with mobility impairments.

An example of how putting more emphasis on rehabilitation engineering and high technology can lead to positive results is an advanced technology training project that is currently being negotiated between the Pittsburgh Office of Vocational Rehabilitation and an institution of higher learning. This project will develop an advanced technology vocational training program in the Pittsburgh area. It will prepare severely handicapped individuals for employment in the highly technical information processing field.

However, training programs like this cost money. We can't continually count on the Federal Government to pay for these programs. The magnitude of the problem is just too great. But if this Nation's private sector employers were encouraged to become more involved in developing high technology training programs, and then assisted with the placement of these severely handicapped individuals into competitive jobs, we will have made tremendous progress toward mainstreaming the handicapped population into American society.

Millions of severely handicapped people could compete on an equal basis with their able-bodied peers for positions in the competitive labor market if they could obtain the rehabilitation services which they need through programs designed to reach them in their homes, in institutions, or which otherwise made the rehabilitation services readily accessible and available. The models for such programs are well-known and their validity established.

For example, through one such model, severely disabled people, some confined to their homes because of the nature of their disability, are earning competitive wages in the high technology information industry as computer programers, microfilmers, data entry operators, inspectors, and other occupations and skills.

The techniques for establishing severely handicapped people in these and in other occupations in competitive industry are known. What is lacking and urgently needed are the resources with which to establish these special programs in all communities throughout the Nation.

In closing, no one can look into the crystal ball and predict with certainty the next technological breakthrough and how it will impact the handicapped population. Educational and communication technology are at the brink of innovations that could significantly satisfy some needs of the handicapped. But unless there is adapted a technology for analysis, development, and application of solutions to practical needs, the impact of future discoveries will be unrealized.

Thank you.

[The prepared statement of Mr. Ramsey follows:]

STATEMENT OF DUKE RAMSEY
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RSEARCH AND TECHNOLOGY
OF THE
COMMITTEE ON SCIENCE AND TECHNOLOGY
AND THE
TASK FORCE ON EDUCATION AND EMPLOYMENT
OF THE
COMMITTEE ON THE BUDGET
U. S. HOUSE OF REPRESENTATIVES

June 10, 1983

Amy Jones, Sam Smith, Walt Tanner, and Donna Williams (all fictitious names) are all severely handicapped individuals who firmly believe that high technology has impacted quite favorably on the handicapped population. They not only are alive today because of technology, but in spite of their very severe handicaps, they are also competitively employed, due in large part to advances in high technology. One individual, who because of his cerebral palsy cannot communicate well, now carries on normal conversation with co-workers, friends, and family through the use of a programmable talking computer. By just pressing two pads, a complete sentence is spoken by the computer. This portable computer also can answer his telephone, call for help in emergency, and completely control his environment at home (lights, TV, etc.). Another individual who is blind, works as a switchboard operator by using a light sensor that tells her which line the incoming call is on. The list of people who are now working because of advances in technology could go on and on, but suffice it to say, technological advances have been of tremendous benefit to this nation's handicapped population.

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1. There must be an improvement in the economy in order for there to be jobs open! We can't afford (both monetarily and psychologically) to have trained, skilled, employable

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Technology is developing aids for the severely handicapped population almost faster than we can talk about them! An example of what high tech can do for a very severely handicapped individual, is vividly shown on the videotape that I brought with me. This short tape produced by the National Institute of Health, visually demonstrates much better than I can verbally, what tremendous steps forward we have made through the use of high technology.

Now, what can the government do which will ease the adjustment of the handicapped work force and the workplace through technology? In addition to helping the nation's employers to accommodate the handicapped worker through the continued use of financial incentives: e.g., the Targeted Jobs Tax Credit Program and On-the-Job training monies, more emphasis needs to be put on research and development for rehabilitation engineering and technology. Recently, a study was completed by the professional development council of the National Rehabilitation Counselling Association to identify major research needs in rehabilitation. Of twelve research categories, the third greatest need for research and development was "rehabilitation engineering and technology." This category contained areas related to the application of advance technology in medical, social, and psychological areas to enhance rehabilitation efforts and to solve the functional problems of handicapped people. Among the research and development topics mentioned were communication devices, engineering applications for independent living and mobility, determination of the most effective barrier-free design criteria, and transportation systems to serve people with mobility impairments.

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Mr. **Walgren**. Thank you very much, Mr. Ramsey.

The one area that everything seems to be on the positive side is in the area of employing handicapped people through technology. I certainly hope we can see some real progress in that area.

What do we have now in terms of financial incentives that are there in the system? You mentioned the targeted jobs tax credit. Do all handicapped people qualify for that?

Mr. **Ramsey**. For the most part they do qualify for that. That acts as a tax credit rather than a tax deduction for an employer—the employer can deduct up to, again depending on the tax bracket he is in, up to half of the first $6,000 of wages for that individual the first year, and a quarter of that $6,000 the second year, for a maximum of $4,500 as a credit. We found that to be very, very beneficial, particularly with the smaller employers—owner-operated.

We can go into the company and show them right on paper, we are handing him a check for a number of dollars "if you hire this person who is as qualified as people you are going to take off the street—you would be a fool not to hire this person here because we are going to give you a tax break."

Mr. **Walgren**. What are the net labor costs using the targeted tax credit? There was an article in the paper recently that said if you were to hire a disadvantaged youth, given the various programs that they might be eligible for, that at least for summertime, and I believe it was summertime employment, the net cost to the employer was 50 cents an hour.

Ms. **Hogue**. That is a special part of the targeted job tax credit legislation, specifically for youth, for summertime employment. It is 50 percent of the wage, up to $6,000 for other individuals, and that declines over a 2-year period. But the 85-percent subsidy is just for youth, and I think it is going to be very interesting to see whether employers take up that opportunity this summer, and whether that does in fact increase youth employment opportunities.

It should be a very strong carrot to employers, stronger really than the subminimum wage for youth in many ways, because the subminimum wage we are talking about may be $2.70 an hour, and with this special targeted jobs tax credit we are talking about only having to pay 50 cents an hour.

In the past, in general, the problem has been that employers have not been particularly inclined to use the targeted jobs tax credit. The take-up rate was about 4 percent. And part of that is attributable to marketing. A lot of big employers seem to find out about the targeted jobs tax credit and use it, but smaller employers, unless you have people like Mr. Ramsey who go and really market the tax credit, a lot of the smaller and middle-sized employers don't know about it, think it is too much government redtape, and are reluctant to get involved in it. So a lot of it is marketing.

Mr. **Walgren**. There is some indication, though, is there not, that because of racial discrimination and the resistance of employers to getting involved with truly disadvantaged youth, and I think that is the only thing you can attribute it to—that when the CETA programs and others have run some projects in which they essentially offered the employee free, they found no takers—literally, no cost employees and no takers.

Ms. **Hogue**. I think you can entice employers to hire people somewhat by subsidizing wages, but employers will not be inclined to keep those people on and some employers don't even want to take the person on if they don't perceive that that person can be a productive worker and can produce something.

Mr. **Walgren**. Which makes it a particularly good vehicle for the handicapped workers, because the handicapped worker, by definition, in most instances is as productive if not more than the others.

But going back, what is the leverage again, and how does it phase out on the tax credit?

Mr. **Ramsey**. Just on the tax credit itself, it has half of the first year's wages up to $6,000, the first $6,000 of wages. In other words, $3,000, that is the way it is, and a quarter of the second year's wages, it is really the first 2 years of employment for a maximum of $4,500.

A maximum of $4,500. Oftentimes, depending on the tax bracket that the employer is in, they don't realize the full $4,500, and I always caution people that go out selling the program to employers not to say they are going to get $4,500 back, because every employer is obviously in a different situation, but potentially that is what they could get back.

Mr. **Walgren**. Has there been any experience after the second year? Is the employment generally maintained by handicapped individuals or does the loss of that tax credit then result in their losing that position?

Mr. **Ramsey**. I have found, again, speaking from my experience working with disabled jobseekers in the Pittsburgh area, that they have for the most part been retained. They haven't been hired solely because of that particular program.

I have read some studies where years ago, when the program first came into play there were abuses, particularly in high-turnover jobs. Employers tended to hire people through these programs and then got rid of them and hired more so they could continually get the funding, but, again, as I must stress, I haven't seen that particular situation among the population that I work with.

There have possibly been a case or two where I have suspected that maybe someone thinking of doing that, but it was never any severe abuse, it was a judgmental decision.

Mr. **Walgren**. You mentioned that you would like to see the private sector become more involved in developing these training programs, particularly the high technology training programs. What should we be asking of the private sector now in this wonderful age of volunteerism. What should we be trying to draw out of them in terms of participation?

Mr. **Ramsey**. Certainly, one area I would like to see expanded, and it was started, I think, primarily through this project with industry, that has been going for a number of years, is where we have employer advisory boards for these particular projects and in fact, this high-tech project that we are working on in Pittsburgh that is a key element, a key component of that program, is going to have employers who are working in the field of high tech sitting on this board, advising the training programs, in fact, helping to design the training programs before they are even set up.

So that they are being trained in areas for which there are going to be jobs. So often that has been the case. We get people coming in, say a disabled jobseeker, comes for our services and is already trained in a particular area that I am 99 percent convinced is going to be obsolete within the next 5 years or so.

It is frustrating to see that continually happening, getting people trained in areas for which there doesn't seem to be a tremendous likelihood of jobs.

If we had more input from employing communities, business community, directly, like we have had with the Pittsburgh Alliance for Employment of the Handicapped, having aboard representatives from various companies and their giving advice: "We really think you shouldn't be putting people in these areas; perhaps this area is better; let's look at this area." I think that kind of dialog going on between rehabilitation people and business community, would be a tremendous service to the handicapped population.

Mr. WALGREN. Are there any proposals of setaside requirement or some kind of very specific way to encourage employers to at least pick up some part of the handicapped community?

Mr. RAMSEY. Not that I know of, no.

Mr. WALGREN. Not that I know of, either.

Ms. HOGUE. I think employers are motivated to participate in some of these test programs, not just by an altruistic spirit, although that certainly motivates some of them, but because they have a self-interest in finding good workers, whether they are handicapped or not, and I think that the Job Training Partnership Act, which was recently passed by Congress and is targeted on disadvantaged individuals, including the handicapped, tries to set up a mechanism for formally involving the private sector in administering, designing, and planning for training programs in local communities and at the State level throughout the country.

In the high-tech area particularly, and in industries that are affected by high tech, I think it is important to know that there are going to be about 4 percent of the jobs in 1990, in high tech. Where the impact of high tech is going to come, is on its application in the workplace.

Right now, a lot of employers can't find workers trained to meet their specifications, so they look to some of these government-sponsored training programs to supply the workers that they need.

So as I say, they, aren't getting involved for altruistic reasons; these programs are producing people that they need with skills they really need. This is an incentive for them to get involved in the beginning in planning and designing the program.

Mr. WALGREN. Mr. Dymally.

Mr. DYMALLY. Thank you. Mr. Ramsey, over the past several days of hearings, we have not been hearing that the unemployment picture in the future will be very rosy. There may be some increased unemployment as well as underemployment.

This means there will be a greater pressure on the few jobs that are available. As you have said in your testimony, more research and development is needed to produce devices and processes that will enable the handicapped individual to gain an equal place in the work force.

Given the general pressure that can be anticipated on the job market, what measures should the government take, if any, to guarantee that the handicapped individual will have a fair shake in the future job market?

Mr. **Ramsey**. That is a tough question. One of the arguments in the rehabilitation community that has been going on for a number of years is the fact whether or not there should be goals and timetables and quotas as there are for other minority groups for the employers.

One of the arguments against that is the fact that who are the handicapped? It is such a broad group of people and can be designed so many ways. A person who wears glasses, in some cases, depending on the type of job that they are doing, could conceivably be considered handicapped.

The question comes up that perhaps employers would abuse it and say, "I only need to have 11 percent of my work force on hand; I have already got 30 percent handicapped; I am not going to hire anybody." That could be a problem.

I am not sure that there is anything that government could do in particular to insure in a tightening economy that more or at least equal number of handicapped would get jobs.

Short of perhaps beefing up the investigatory process that goes on now through OFCCP, Office of Federal Contract Compliance Programs, when there seems to be blatant cases of discrimination because of handicaps.

Those measures have proven to be very beneficial in the past, although they do tend to take forever and forever to get resolved, but they do seem to produce. But because of sheer definition of the word "handicapped," I really don't know whether it is that easy to say there is something government can do directly to see that they get their fair share.

Mr. **Dymally**. Thank you very much.

Ms. Hogue, I would like to ask the same question about the distribution of women and minorities in the labor force as I asked Mr. Ramsey about the handicapped. Do women members of minority groups cluster in certain occupations?

If they do, how vulnerable are their jobs to advances in technology, and what, if anything, can the government do to see that women and minorities are not displaced by the advances in technology?

Ms. **Hogue**. Well, yes, indeed, woman particularly are clustered in a certain group of occupations and they are often low-pay occupations.

I think it is interesting, in the last recession, we saw it affect largely men and we look at the high-tech industry and we see that women and blacks and Hispanics are probably going to participate in the high-tech industry initially in assembly kind of jobs, general manufacturing jobs. Those are the jobs that are most vulnerable to displacement in high-tech.

In order to compete in the labor force of today, in order to compete in the labor force of the future, it is going to be important for individuals to have good basic skills and I think there are some things the government does, things now at the Federal level and State and local level to encourage the development of good basic skills.

Basic skills don't mean just reading and writing and computation, in the future, they are going to include problem-solving skills and computer knowledge skills. I don't really agree with Mr. Rumberger that we don't have to worry about getting computers into inner city schools because not everyone is going to grow up to be a programer.

I think we are talking about access to opportunity for all groups and if you want access to opportunity, then you have got to have quality education and access to computers in inner city schools as well as in suburban schools.

So I think basic skill improvement is a critical area. One area where we have not, I think, sufficiently dealt with the problems of black and Hispanic youth, and to a certain extent, low-income women, is in the secondary schools.

Young people that fall behind in the elementary schools do have the advantage of title I now chapter 1 of the Elementary and Secondary Education Act, which really provides and has stimulated State and local spending and remediation for elementary school students.

We do not have anything comparable to that, really, on a nationwide basis, focused on secondary school students and these are the students that often drop out of school, they just can't stay in school because they can't understand, they get frustrated, they drop out, and so I think that is a gap in our education system that we need to pay attention to in the future.

Certainly, also, I think, we need to be concerned about excellence in education. We can look to employment and training programs for some ideas on what can be done to improve our school system. We have learned through training and employment programs how to set performance standards for young people so they can improve math and improve their reading competency and you can measure that. We can measure achievement in vocational skills.

We need to apply those, so young people are measured on what they are achieving in school.

Mr. **Dymally**. Thank you, Mr. Chairman.

Mr. **Walgren**. Thank you, Mr. Dymally.

Ms. Hogue, you indicate in your guides to the future as to what we ought to do, that more attention should be paid to the link between education and work and success in the workplace, and you indicate that much has been learned about how students can make the transition from school to work.

Can you develop that a little more for me?

Ms. **Hogue**. Well, I think that we know that students need good basic skills to succeed in the workplace. I mentioned that before.

We have learned that students who stay in school and finish high school have a better opportunity to succeed in the work place than students who drop out of school. So, for about the 25 percent of American high school students who don't complete school, there is a target group to focus on.

That is one thing, the dropouts. I think getting children to stay in school is important.

Increasing their competency while in school is the second important thing, as I mentioned. The third thing is that a lot of young people see no relationship between what they learn in school and the world of work. They see no reason to stay in school because they can't figure out why it's important. My daughter is in the sixth grade. She said to me the other night, doing her homework and diagraming sentences: "Mom, will I have to do this when I have a job?", and I said, "I haven't done it lately, but I always thought it was fun to learn to do". Students really need to see some relationship between what they are learning in school and what they are going to have to do in the business world.

I think there have been some very successful programs that try to involve business people in the school system. Some individual companies, such as Digital, Rockwell International, IBM, Control Data, send their personnel into the school systems to talk about the world of work, to talk about the kinds of jobs that are available. GE runs career-awareness programs for teachers in the summer, so teachers can be brought into some of the plants to see what the new technology is meaning, so they can go back into the classroom and excite their students in this area.

There have been very successful adopt-a-school programs where businesses adopt a school and then put resources and personnel into that school to help work with students.

There have been a number of successful programs, I think, that try to help students relate the world of school to the world of work.

Mr. **Walgren**. You touch on the disincentives of the main payment systems that we have for somebody to go out and find work, just as others have touched on that, and you suggest the employment counseling be integrated into the receipt of unemployment insurance.

Where are we on that? Is this being done? Is that not able to be done right now?

Ms. **Hogue**. It can be done now under certain circumstances. I think there are a couple of barriers to it now. First of all, resources. The employment service which might be the logical provider—which does, in fact, do a work test for unemployment insurance claimants— does not have the resources to adequately counsel and refer people to programs.

Resources for providing and paying for training for displaced adults are not available. However, the Congress just passed the Job Training Partnership Act. Under Title III of the act, there is a new program for displaced workers. It is in a startup phase right now. When it is fully operational, I think it will provide some opportunities for retraining.

I think another thing that is a barrier is just the way we think about our systems. We think about the unemployment insurance system separate from the job-training system. We think about it as an income maintenance program, and it is a very important income maintenance program for certain groups of people, certainly for people that are on temporary layoff.

We haven't been confronted with very large-scale problems of displaced workers. We have thought of the program in terms of a temporary income support program. Now, we are all of a sudden confronted as we haven't been since 1962 with a large number of displaced workers, people that are never going to go back to their former jobs, and I think it is just a matter of rethinking, the link between unemployment insurance and retraining.

In some States, however, you cannot remain on unemployment insurance and get into training programs. The States have a variety of different rules governing that.

But in a great measure, I think there is nothing that really prevents us from doing that, other than a lack of resources and a lack of thinking about the problem in terms of linking the two systems.

I think it is such a commonsense idea; you really kind of wonder why we don't do it as a matter of course. There are some changes that would have to be made in State law, in some cases and the provision of resources to pay for the retraining.

That is a big issue, I think. We sort of guarantee young people in this county access to higher education and we think they are going to go on to higher education and we have a system to pay for it.

We really don't have a system to provide training for adults. Maybe we need to think about that in the future.

Mr. WALGREN. Mr. Ramsey, it strikes me that it is probably pretty interesting and easy for people in academia or in some institutional social studies framework to spend their time thinking about these things and proffering opinions. You, on the other hand, have a hands-on involvement in trying to find work for people.

How is it that you don't become a discouraged worker, and I guess what I am fishing for is what are our rates of success in this area? How many times are we discouraged versus encouraged?

Are we really in a situation in which we talk about retraining but—you mentioned being a little apprehensive—many of the times the retraining programs don't have jobs at the end of the line and may be aimed at the skills for which there might not be a job there after all those expectations have been created.

What is the rate of burnout in people who actually try to deal with this problem rather than just talk about it?

Mr. RAMSEY. That is a tough, purely subjective answer, of course, on my part, but from my perspective, the rate of burnout using the traditional word discouragement, goes up, as unemployment goes up, as the problems go up.

I certainly appreciate the confidence that I continue at a high level of enthusiasm to do. However, you ought to see me on some mornings when I come in and find out someone got laid off, I just helped get a job last week, it does become very discouraging of course.

Who is to say why some people burn out quicker than other people? I certainly don't have that answer. But, more important, I think on our part, us becoming discouraged or burned out, what is incredibly frustrating to me is the discouragement that was alluded to earlier in the work force among the handicapped population.

In fact, it is so discouraging, that the labor market analysis staff in the Pittsburgh area dropped the handicapped from labor projections in their annual planning report for fiscal year 1983.

They don't even mention the handicapped any more. I went to get it, which is like the Bible for your statistics on planning the old CETA projects, grants or JTPA, that is, you quote the statistics, black unemployment population, in Pittsburgh is *x* percent, women—I kept looking through thinking I was not finding it, I didn't know where it was, there wasn't any data on handicapped, I called them up and they said they decided not to, whoever decided someone higher up decided not even to cover the statistics on the handicapped, so we can't even get the data to find out how many percentage of unemployment even, but, as you mentioned on the day-to-day front line, if you will—I am working on—the discouraged work force that you mentioned earlier—I think is much, much higher than any projections might be made, particularly among the handicapped.

Someone can come into their house and say, "Are you looking for work?" "No, I am not looking for work." I think more the question should go way back, you even think there is remotely a possibility you could get a job some day. That is the reason I think so many particularly severely disabled people aren't looking for work.

We run job clubs 5 days a week where we have groups of clients coming in and trying to develop skills and teach them how to make phone contacts. It is unbelievable how discouraged I get on not seeing any progress on that.

It doesn't surprise me that we have so many of them quit coming in. Even financially there is no expense for them. We will pick up the cost of them coming in by bus transportation, we will do resumes, what have you, you sit there and make 10 or 15 or 20 contacts a day and don't even get an interview out of any of those contacts, it is amazing to me that we have people still coming in.

I don't think any of us in the field are immune to burnout, particularly nowadays, it is reaching epidemic proportions. People are just so discouraged and they don't know where to go, you go and knock on doors of employers and ask them for help and they just look at you and kind of shrug their shoulders and say, "You are not alone, everybody is looking for a job."

Mr. WALGREN. That is a good point to stop.

Would you like to——

Ms. BACH. Ms. Hogue, I would like to ask a question, you touched on the topic briefly and that is with regard to postsecondary employment. You mentioned that students learn from example of follow lines of employment based upon what they see in practice.

One concern that I have in looking at the distribution of employees in the postsecondary level is that you do not see a lot of Hispanics, blacks and/or women. I am wondering, from your experience, what receptiveness you have gotten from postsecondary institutions as to increases in those three areas for employment?

Ms. HOGUE. Well, I think probably when you look at the statistics, some of the increases in participation in postsecondary education, first of all, you are talking about the average college, is that what you are talking about?

Ms. BACH. I am talking about college graduates.

Ms. HOGUE. Right. I think that the increases for all those groups in college participation, and getting college degrees has increased dramatically, but you started from such a small base that it appears that you are not really making all that much progress when you take all students into consideration.

Certainly, for blacks, who do complete college, and for Hispanics as well, and certainly for women, their chances are much improved and affirmative action policies have made a difference, in this regard, but there is certainly much more that can be done.

Ms. BACH. In terms of trying to retain instructors at the postsecondary level, what you are seeing there in these minority groups? That is really what I am looking for. There is a concern that we can't keep teachers at the postsecondary level.

Not only can't we keep male teachers, but we don't even have a large proportion of minority groups in those areas of teaching. Yet we are saying to a student in math or science that we would like to encourage them to go into the educational field. Well, they don't see an example there, they didn't see their groups being represented in a postsecondary position, and I think that there is less encouragement for them to consider that a possibility for employment.

Ms. HOGUE. Well, I think what probably discourages people from going into the education field today are two things: One, people perceived over time there was a glut in the education field and there weren't a lot of jobs available; and the second factor is the pay, the rate of pay.

Obviously, whether you are black or Hispanic or white or male or whatever, and you can command a better salary on the outside, you are going to take that salary. It is interesting that in the 1950's, when Congress passed the National Defense Education Act, it encouraged lots of people to go into teaching, so many that we ended up with a glut of teachers. As people perceive that there are jobs available in the teaching field, people will be encouraged to go into those fields.

In terms of the specific groups you mentioned, and they are making inroads into the education field, I would imagine it is like anything else; if the best people are drawn out of education, into industry, or by industry, because they can command higher salaries, then opportunities will open up in education. I am not implying that that doesn't mean other good people won't go into education, it is just that there will be opportunities opened up within the education field and women and blacks and Hispanics should be able to take advantage of those opportunities.

But honestly, women and blacks and Hispanics have been recruited very actively by businesses, and so education is also forced to compete for those groups.

Ms. BACH. Thank you.

Mr. Ramsey, I would like to ask a question, it is actually twofold, and that is it appears maybe the point that good things sometimes come out of those which those are bad applies when we talk about moving into high technology and eliminating occupational fields, but one thing we have been able to do is help the handicapped.

In that regard, have you—I would like to bring up another point—on Tuesday, this week, we had Dr. Dave Birch from MIT testify. He pointed out that the increases in jobs when you are talking about businesses, that is coming more from the small business as opposed to the Fortune 500—so my question to you would be, what data or what trend do you see in terms of those small businesses which are supposedly creating new jobs, how many of those are handling and hiring handicapped?

If this is a field that is going to be increasing, what do you see from those small businesses, under a lot of pressure to succeed, and to maintain themselves, what are you seeing in terms of handicapped employment with them?

Mr. **Ramsey**. We are seeing a larger percentage, I think, of numbers in terms of numbers of people, of handicapped people, getting jobs, going into the smaller businesses rather than the traditional large—United States Steel, Rockwell Corp., places like that—they continue to be a mainstay, certainly, in some areas of employment.

The smaller businesses are tending to hire more of "our people," established jobseekers, than the larger ones. What it boils down to, more than just numbers is ultimately what it is, an educational selling process on our part.

I chair, in Pittsburgh, a task force on employment of handicapped for the mayor, and we got a new member who is a director for personnel for a corporation, and I was talking to her about her perception when she is meeting with other personnel directors, how they view the handicapped job worker. She was very honest in saying it was plain and simple fear; it wasn't any blatant discrimination. Collectively, we are going to get together and not hire the handicapped. They actually aren't familiar with all the terms, potential medical problems, if you will, whatever, and they count on people in the field of rehabilitation to come in and sell the program to them to explain to them what is going on.

I have always found, over the years, it seems to me to become easier talking to employers if you sit down and talk to them, and you can get the employer to voice their concerns—which oftentimes they are particularly smaller employers—right away, they are thinking, "I can't absorb a loss as much as a larger employer will."

I have heard that one a lot. If I sit down and try and convince them anyway that is not going to be the problem, in fact, statistically, they have a better employee in the handicapped worker than they will in the nonhandicapped—all studies indicate that. I always happen to have a supply to show them. As I said, it is educational, they generally do come around and are willing to try. If we have a success on the first time with an employer, we usually have a solid employer on our part.

Yes, I would say that, in the future even more so, smaller employers are going to be where we are going to be placing people. Interestingly enough, probably the government, the Federal Government particularly, has been in the past a tremendous employer of the very severely disabled worker. They tend to, I don't know why, tend to experiment more, if you will, on hiring the severely disabled, and it has been very beneficial in turning it over to the private sector, because we can show certain jobs that have been done whether it was for government or not. A person has been productive on the job and we can turn around and go to the private-sector employer and show things like that can be done like homebound employment and flexible working hours.

Ms. **Bach**. There may be an obligatory factor when you are talking about handicapped being employed by the government in terms of government feeling responsible to help out in some way. Yet it seems that the private sector has to be encouraged into understanding that the handicapped person is a responsibility, for everyone, not just for government agencies or government-associated employment but that the private sector also has to be encouraged to participate and have some sort of responsibility.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you very much.

We appreciate, on behalf of the committee, your contribution to the record and to the entire action here today and the committee stands adjourned.

Mr. DYMALLY. Mr. Chairman, I am pleased to hear that this committee is going to come out to southern California. I would like to extend a specific invitation for you to come to the 31st District, in which are located a great many high-technology companies, sometime in the summer recess. We look forward to your coming out again to explore this very important subject.

Mr. WALGREN. We look forward to it, too.

Thank you, Thank you very much.

[Whereupon, at 12:35 p.m., the subcommittee and the task force adjourned.]

TECHNOLOGY AND EMPLOYMENT

TUESDAY, JUNE 14, 1983

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY; SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY, AND THE COMMITTEE ON THE BUDGET, TASK FORCE ON EDUCATION AND EMPLOYMENT,
Washington, D.C.

The subcommittee and task force met, pursuant to call, at 9:50 a.m., room 2318, Rayburn House Office Building, Hon. Doug Walgren (chairman of the Subcommittee on Science, Research and Technology) presiding.

Present: Representatives Walgren, Gephardt, Dymally, Mineta, MacKay, Sensenbrenner, and Skeen.

Mr. WALGREN. We will come to order.

I apologize for missing the 9:30 starting time.

Today is the third day in this series of hearings held by the Subcommittee on Science, Research and Technology and the Task Force on Education and Employment of the House Budget Committee, cochaired by Congressman Dick Gephardt and myself. Congressman Gephardt is not able to be here at the start this morning, but we expect him sometime during the day.

We are trying to make a record that will be a real resource for both of these two committees and other Members of Congress in trying to understand what the changes that we are going through in our workplace mean for our economy. It is pretty clear in most everyone's mind that this society, as we know, cannot run on substantial levels of unemployment. Our obligations to each other literally need the contribution that work provides to the social fabric in tax revenue to support the obligations which we do recognize for each other, such as social security and the like.

We are concerned that the changes we are going through will either confront us in the longrun with substantial unemployment or cause such major dislocation in the shortrun that we may suffer a substantial recession and miss a number of years of that contribution and, therefore, miss much of what our country could be.

The first panel today was asked to discuss automation in factory and the office. They are Linda Lampkin, the director of research, American Federation of State, County, and Municipal Employees; Peter Cunningham, the president of INPUT Corp.; and Lynn Williams, the international secretary of the United Steelworkers of America.

I believe Ms. Lampkin and Mr. Cunningham are present. Mr. Williams is on his way, I believe. I would ask those folks to come forward and we will start.

Let me say that, in the interest of time and our ability to distribute the time fairly, we have allotted about 10 minutes for each presentation. We have a red light there that, after 10 minutes, will go on, and that will be a signal that you needn't stop immediately in midthought, but that, in the interest of being fair to the others who will also be testifying, if you could at that point bring it to a close.

Your written statements will be made part of the record in full. That also goes for any other thoughts that you might want to submit for the record as the day goes along.

So let me ask—and we will start in the order that I called you—if you will proceed and communicate with the committee in the way you feel most effective. We would be pleased to have your perspectives.

[The biographical sketch of Ms. Lampkin follows:]

BIOGRAPHICAL DATA

LINDA M. LAMPKIN

Ms. Lampkin is Director of the Research Department for the American Federation of State, County and Municipal Employees.

She is responsible for responding to requests from AFSCME's over 3,000 locals and councils throughout the country for economic data and comparisons of wages, benefits and contract language needed for negotiations, and for technical advice on other issues of importance in the field and supervises a staff of 15 professionals. She also works with the rank-and-file-member committees of clerical workers, professionals, private non-profit agency employees, corrections personnel and school workers for the national union.

Prior to joining AFSCME, Ms. Lampkin was Research Director of Retail Clerks Union Local 770, a 25,000 member local in Los Angeles for four years, and was a management consultant in compensation for three years. She has also taught college courses in Labor Relations, Micro and Macro Economics, and Business.

Ms. Lampkin holds a Bachelor's degree in Economics from Cornell University and a Master's degree in Labor Economics and Statistics from Cornell's School of Industrial and Labor Relations.

STATEMENTS OF LINDA M. LAMPKIN, DIRECTOR OF RESEARCH, AMERICAN FEDERATION OF STATE, COUNTY, AND MUNICIPAL EMPLOYEES; PETER A. CUNNINGHAM, PRESIDENT, INPUT CORP.; AND LYNN WILLIAMS, INTERNATIONAL SECRETARY, UNITED STEELWORKERS OF AMERICA

Ms. LAMPKIN. Thank you.

My name is Linda Lampkin. I am director of research for the American Federation of State, County, and Municipal Employees. AFSCME represents 1 million workers in State, local, and Federal governments and private nonprofit organizations. Over 200,000 of our members are clerical workers, and tens of thousands more are professional and technical employees who work primarily in office settings.

Nowhere has the issue of automation taken as strong a hold or achieved as much visibility as among our office workers. It is a major issue today, in spite of the fact that public and private nonprofit employers are only in the beginning stages of office automation.

As a general policy, AFSCME supports the introduction of new technology that improves the quality of life at work and outside of work and that enables us to improve the quality of services we provide. We recognize that new technology, properly implemented, offers potential benefits to workers and the public. In spite of that potential, experience shows that often jobs are made more routine, more unskilled, more unhealthy, lower paying, and more dead end with the introduction of new technology.

AFSCME has called for a number of steps, including encouraging a study by the Federal Government to determine the impact of technological change on employment, income, and working conditions of all workers, with the ultimate aim of developing a national policy and programs for dealing with technological change. So I am very glad to have the opportunity today to address your committees.

AFSCME has five major concerns with office automation First, safety and health; second, work reorganization; third, job security; four, impact on overall employment in the economy; and five, special impacts on particular groups of workers—for example, women, minorities, older workers.

Some of these issues we can address and we are addressing at the local bargaining table. However, we feel there is a Federal role in each of these areas, a role that encompasses such things as funding scientific research, dissemination of information, and development and enforcement of standards.

The first area is safety and health. Some basic safety and health problems associated with visual display terminal equipment include visual and musculoskeletal problems, radiation damage—these are the things that are talked about. Many different equipment designs for VDT's are now on the market and, because of feedback from users, pressures from unions here and abroad, VDT manufacturers have incorporated a number of useful features in recent models. However, the economics of office automation are such that most employers will not invest in that better-designed, more adaptable—but perhaps more costly—equipment unless pressured by the workers, pressured by Government regulation, or by a noticeable decline in productivity resulting from an extremely bad work situation.

In addition, both employees and their union representatives, and employers, are faced with an extremely complicated and costly search process should they try to thoroughly evaluate all of the equipment that exists.

The other aspect, VDT radiation, is a very controversial issue. Right now, there are scientific questions surrounding the current standards, methods, and instruments for determining whether a hazard exists. The debate is not just about VDT's; the debate is really about how little is actually known about the effects of long-term exposure to low levels of radiation. Comprehensive and well-funded research into the potential radiation hazards must continue. In the meantime, we want to err on the side of safety.

We see a Federal role in addressing the safety and health issues associated with office automation in several areas: One, to fund continuing research into health effects of machine design and the exposure to low-level radiation; two, to establish a central source of information on equipment, for users as well as purchasers, including evaluations that deal with the issues that concern users; three, to set minimum standards based on current and future experience and research which will reduce chronic health effects and safety problems, in such areas as flicker rate, adjustable screen angle, adjustable screen brightness, and so forth.

Our second major concern is work reorganization. The VDT equipment itself is a relatively small part of the change to office automation. Some of the major problems for workers do not result from the machinery, but from the way the employer uses the machinery to redesign work. The ability of a computer to handle many complex tasks in a routine way may be used to give the thinking aspect of the job to the machine rather than to the person, leading to deskilling jobs.

Jobs for many VDT workers could center around following set routines that require little training, leading to lower pay and increased use of part-timers or home workers who receive few or no benefits. Intensifying work effort for routine word processing data entry operators will exacerbate whatever safety and health defects exist in the equipment itself. The increased stress will bring about increased levels of anxiety, irritability, depression, chronic health problems such as high blood pressure, and heart disease. Addressing these matters is not a matter of improving equipment. If you have a comfortable chair, if you have proper lighting, if you have an adjustable screen with a soothing color, it only goes so far to deal with the problems of 7 or 8 hours of the day sitting at a VDT. A nationwide standard is needed to protect workers from the long hours that lead to these chronic health problems.

Office automation has other serious effects on office workers. AFSCME clerical employees have a tremendous thirst for knowledge and training on the latest office machinery. But this is often frustrated because there is no comprehensive training, because equipment is improperly designed, and because many times the employer is reorganizing work to minimize the skills needed by operators.

Much now is being said about the need for computer literacy. National policy should insure that computer training and education is provided to prepare workers for the variety of jobs that they can expect to have throughout their work life. The Government can fund such training, and can also encourage union-sponsored or joint union-management sponsored training programs to help teach these skills. If employers are responsible for training workers, there is a real danger that the training will be too job specific and will quickly become dated. Those currently at work must have prospects for job mobility for the rest of their careers, and they must have skills to compete with future entrants to the labor force, those who are now in school learning to deal with computers as a natural part of their lives.

The ultimate impact of office automation, we feel, is probably not to eliminate large numbers of low-level clerical jobs, rather it is going to pay for itself by eliminating large numbers of highly skilled and versatile clerical, secretarial, low and middle management positions. In fact, a recent study of the banking industry in England revealed that new technology and the reorganization strategy that accompanied it have already reduced the paths of advancement through the organization. It is creating a two-tiered stucture—clerical low-level functionaries, and upper-level professionals and decisionmakers.

Federal policy must address the dangers inherent in the development of this kind of two-tiered organization, and perhaps from there a two-tiered society. Fewer routes for advancement to higher-paying status jobs, routes which have only been recently developed for and opened up to a limited number of women and minorities, can have a substantial economic and social impact.

The next issue is job security. For AFSCME members right now, we have more immediate problems with the impact of the recession and Federal budget cuts on jobs. However, over the longer term, the reorganization of work in the office of the future will also have an impact on job security. Office employment may eventually decline as organizations learn how to standardize more and more of their information, and take better advantage of new technologies. The individual worker who is displaced must have some kind of basic support structure providing retraining for another job within the organization or outside of the organization.

There must be a new source of job growth to absorb the loss of domestic manufacturing jobs and those office jobs which I just mentioned. This, we believe, is going to be the central economic and social problem of the next few decades, and it is far beyond the capacities of any single union, employer, or industry to resolve.

Special impacts—I am going to wind up quickly here, my red light is showing—office automation affects women, of course, in particular, especially as it fosters dead-end jobs. Again we are eliminating the career advancement potential. Also, patterns of sex discrimination that are common in traditional industries are being quite nicely carried over to the new high technology industries—discrimination in wages, higher level positions, and so forth.

Older workers, untrained in VDT operation, may also face special problems. The willingness of an employer to provide job training for older workers is going to be an issue.

These are some of AFSCME's basic concerns with office automation and possible directions for national policy in the future. There are other potential problems that I have not even mentioned yet. We are going to have problems with increase in computer homework. We are going to have a problem with the ability to use satellites to transmit information perhaps even outside of the United States.

As a union, we are doing what we can through collective bargaining and education to help our members prepare for jobs in the future. This involves the recognition that technology can bring innumerable benefits, but also that it can impose very high costs on the individual and on society as a whole. The job of taming technology to be at the service of all Americans is a job that is too big for us or any single organization. We need to consider the issues carefully as a society and to plan carefully as a society for a future that, for better or for worse, will transform the way all of us will live and work.

Thank you.

[The prepared statement of Ms. Lampkin follows:]

Mr. WALGREN. Thank you very much.

TESTIMONY
OF
LINDA M. LAMPKIN
DIRECTOR OF RESEARCH
AMERICAN FEDERATION OF STATE, COUNTY AND MUNICIPAL EMPLOYEES

My name is Linda Lampkin and I am the Director of Research for the American Federation of State, County, and Municipal Employees. AFSCME represents one million workers in state, local and federal governments, and private non-profit organizations. Over two hundred thousand of our members are clerical workers, and tens of thousands more are professional and technical employees who work primarily in office settings.

AFSCME members in all occupations are finding it necessary to understand how technology is affecting - and will affect - their work lives. Health care professionals and technicians are seeing their jobs changed by new procedures for lab tests and new equipment for monitoring and treating patients. Blue-collar support staff in institutions are beginning to face the introduction of robots and other kinds of automated service systems. Refuse collectors are learning to operate a new generation of highly-mechanized collection equipment, and seeing their ranks thinned as a result. Nowhere, however, has the automation issue taken as strong a hold, or achieved as much visibility, as among our office workers. It is a major issue today in spite of the fact that most public and private non-profit employers are in the beginning stages of office automation.

As a general policy, AFSCME supports the introduction of new technology that improves the quality of life at work and outside of work, and that enables us to improve the quality of services we provide. We recognize, in the words of a resolution on new technology passed at our International Convention last summer in Atlantic City, that "New technology, properly implemented, offers potential benefits to workers and the public. These benefits include: safer and more comfortable working conditions, the opportunity to learn new skills and perform more skilled work, more efficient delivery of services and the freeing of resources to expand and improve services. In spite of the potential," our resolution continues, "experience shows that often jobs are made more routine, more unskilled, more unhealthy, lower-paying and more dead-end with the introduction of new technology."

This resolution, which is attached, calls for a number of steps, including encouraging a study by the Federal Government "to determine the impact of technological change on employment, income and working conditions of all workers with the ultimate aim of developing national policy and programs for dealing with technological change and its effects." So I am glad to have the opportunity to address your committees.

Major Concerns with Automation

AFSCME's major areas for concern with office automation,or indeed with any new workplace technology, include:

1. Safety and health
2. Work reorganization
3. Job security
4. Impact on overall employment in the economy
5. Special impacts on particular groups of workers -- in this case, women, minorities, and older workers

Some of these issues can be addressed at the local bargaining table, but there is a federal role in each of these areas - a role that encompasses funding scientific research, dissemination of information, and development and enforcement of standards.

Safety and Health

Some basic safety and health problems associated with video display terminal (VDT) equipment include:

- visual and musculoskeletal problems resulting from poor ergonomic design of the equipment and of the work setting
- radiation damage caused by long-term exposure to low levels of radiation.

A poorly designed or poorly maintained VDT may have a display that flickers, is dull, or offers a combination of character color and screen background color that causes fatigue and eye strain. A badly designed work environment can produce glare on the screen. Chronic headaches and eye strain are common complaints among frequent VDT users. Backaches, neck aches, wrist tendonitis and carbal tunnel syndrome can be the result of equipment that is poorly placed in one's work area or is not adaptable to differences in users' heights and preferences for viewing distance. Lack of appropriate auxiliary equipment, such as comfortable chairs and wrist rests, can also increase physical ailments resulting from VDT operation.

Many different equipment designs and features for VDTs are now on the market. Thanks to feedback from users and pressure from unions here and abroad, VDT manufacturers have incorporated a number of useful features into their more recent models. These include tiltable display screens, contrast controls, and detachable keyboards (connected by a coiled cord to the display screen) which make the equipment more adaptable to the individual worker and particular work space. Specially-designed document holders are available with some equipment to make it easier for data entry operators to work simultaneously with a paper document and the electronic display. Glare screens are available in those situations in which office lighting has not been redesigned. Some new offices may have "variable lighting" at work stations so that an appropriate amount of light is available for each kind of task--using the VDT, or doing other work.

The economics of office automation, however, are such that most employers will not invest in the better-designed, more adaptable but perhaps more costly equipment unless pressured by their workers, by government regulation, or by a noticeable decline in productivity resulting from an extremely bad work situation. Neither are employers likely to make an investment in peripheral equipment or in redesign of the office itself. Finally, both employees and their union representatives and employers are faced with an extremely complicated and costly search process should they try to thoroughly evaluate all of the equipment and options available.

The impact of VDT radiation on operators is a controversial issue. This is because of scientific questions surrounding the current standards, methods, and instruments for determining whether a hazard exists. The debate extends beyond just VDT research and centers on how little is actually known about the effects of long-term exposure to low levels of radiation. Although research to date has not proven that radiation from most VDTs - even poorly maintained ones - is at hazardous levels, there have been reports from several work places in the U.S. and Canada that the incidence of cataracts has increased with the use of VDTs. From other offices, there have been reports of an increased rate of miscarriages and birth defects. Comprehensive and well-funded research into the potential radiation hazards of VDTs must continue. In the meantime, we must be willing to err on the side of safety.

We see a federal role in addressing the safety and health issues associated with office automation in several areas:

1) To fund continuing research into the health effects of machine design and exposure to low-level radiation - research that will lead to developing equipment and workplace designs that address the needs of workers;

2) To establish a central source of information on equipment, for users as well as purchasers, including evaluations according to a set of criteria that address the concerns of users;

3) To set minimum standards based on current and future experience and research, which will reduce chronic health effects and safety problems, for such areas as:
   - flicker rate
   - adjustable screen angle, adjustable screen brightness and detachable keyboards
   - adequate office lighting
   - standards for maintenance of equipment
   - regular eye examinations for VDT operators

Work Reorganization

The VDT equipment itself is a relatively small part of the change to office automation. Experience with VDTs suggests that some of the major problems for workers do not result from the machinery itself, but from the way the employer uses the machinery to redesign work. Computerized office equipment can make routine daily tasks much more bearable and easier for all white-collar workers. The computer at the heart of the VDT can also be used, however, to measure work output and work performance, using some quantifiable but overly simplistic measure such as "number of keystrokes" per hour.

The ability of a computer to handle many complex tasks in a routine way may be used to give the "thinking" aspect of the job to the machine rather than to the person, leading to "deskilling" jobs. Jobs for many workers could center around following set routines that require little training, leading to lower pay, and increased use of part-timers or home-workers who receive few or no benefits.

The redesign of work through office automation has a number of consequences. Intensifying work effort for routine word processing and data entry operators will exacerbate whatever safety and health defects exist in the equipment itself. The increased stress will bring increased levels of anxiety, irritability and depression. Stress is also associated with chronic health problems such as high blood pressure and heart disease and with higher rates of divorce and other family problems. Addressing these problems is not a matter of improving equipment. A comfortable chair, proper lighting, and an adjustable screen with a soothing color can go only so far in eliminating the stress, visual strain, and fatigue from seven or eight hours a day at a VDT, performing repetitive tasks done at the machine's pace.

A nationwide standard is needed to protect workers from the long hours that lead to chronic health problems. The following guidelines should be considered:

- the NIOSH recommendations that operators be allowed a 15 minute break for every two hours of work on a VDT when engaged in tasks of low visual demand, and a 15 minute break every hour when the visual demands or repetitiveness of a task are high (such as keypunching, or scrolling a screen to review, search, or edit material).

These breaks would be used to perform other tasks unrelated to the VDT.

- limiting operators to spending only up to 50% of their workday on VDT work, with the other half spent on different tasks; this type of legislation is currently proposed in Norway and has been achieved in a number of labor contracts in Sweden.

In addition to the physical health of the office worker, office automation has other serious effects on office workers. AFSCME clerical employees have a tremendous thirst for knowledge about and training on the latest office machinery. This thirst is often frustrated by the absence of comprehensive training, the improper design of equipment and surroundings, and more often than not, by a reorganization of work that seems to minimize the skills needed of operators. Many observers point out that the office of the future will be like the factory of the past, with regimented, closely supervised office workers performing narrow and routine tasks after receiving rudimentary and task-specific training.

Much is now being said about the need for "computer literacy." National policy should insure that computer training and education is provided to prepare workers for the variety of jobs that they can expect to have throughout the 35 to 40 years of their working lives. Government can fund such training, and encourage union-sponsored or joint union-management sponsored training programs, to help teach these skills. If employers are responsible for training for people currently working, there is a real danger that the training will be too job-specific, rooted in the design of a particular workplace, a particular piece of hardware, or particular software. General training for computer literacy is important if those currently at work are to have prospects for job mobility for the rest of their careers and the skills to compete with future entrants to the labor force, who are now in school learning to deal with computers as a natural part of their lives.

Finally, although the implications of the reorganization of the office on the individual worker are major, consider the impact of technology on the organization as a whole and on broad occupational groups. It is now recognized by many observers and purveyors of the office of the future that the ultimate impact of office automation may not be to eliminate large numbers of low-level clerical jobs. Rather, office automation will pay for itself by eliminating large numbers of highly-skilled and versatile clerical, secretarial, and low and middle-level management positions. A recent study of the banking industry in England revealed that new technology, and the reorganization strategy that has accompanied it, have already begun reducing the paths of advancement through the organization and is creating two very distinct tiers of clerical/ low level functionaries and upper level professionals and decision-makers.

Federal policy must address the dangers inherent in the development of a two-tiered organization -- and by extension, perhaps a two-tiered society. Fewer routes for advancement to higher paying jobs -- routes which have only recently been developed for or opened up to, a limited number of women and minorities -- can have a substantial economic and social impact.

Job Security and Overall Employment Impacts

The reorganization of work in the office of the future will have an impact not only on the quality of jobs, but also on job security, and overall employment, the next major areas of our concern. For AFSCME members in the public and nonprofit services, jobs are much more immediately threatened by the impact of the recession on government revenues, and federal budget cuts. However, office employment may eventually decline as organizations learn how to standardize more and more of their information and take better advantage of the technologies that are available. The individual worker who is displaced from an office job must have a basic support structure that provides retraining for another job within the organization, or training and other assistance for a job elsewhere in the economy.

Collective bargaining aims to provide these basic securities at the level of the single employer for the current work force. The problem for the economy as a whole, however, is that even if no current workers were laid off because of technology changes, there must be a new source of job growth to absorb the loss of domestic manufacturing jobs, and the stagnation and eventual shrinking of office employment. This, we believe, is a central economic and social problem of the next few decades, and is far beyond the capacities of any single union, employer, or industry to resolve. Now, for example, less than two years after the phrase "hi-tech" became popular, articles in business journals and statistics compiled by the Bureau of Labor Statistics show that job growth in that sector will be inadequate to provide all the jobs for the growing work force in the next two decades. The sources of increasing jobs in the 1960's and 1970's - private and public services - are themselves the targets of automation and cost-cutting. As the issue of employment in the computer age in the coming years is studied, the solutions will probably incorporate targeted investment in job-creating products and services in the private and public sector, and a shorter work week and working life, without reductions in the standard of living.

Special Impacts on Women, Minorities and Older Workers

Finally office automation will ultimately provide new work tools to the men who comprise the bulk of the executive and managerial work force. However, its most adverse impact will be on women - many of them minority women - who comprise over 80 percent of the clerical work force. Some of the problems faced by women in the computer age include:

- dead-end jobs -- technology inspired organizational models in the 1980's will reduce the number of paths from entry level clerical positions to middle level secretarial and administrative positions. For the clerical worker, moving up in the computer age may be more aptly called navigating a career tightrope, over a variety of continuing and unpredictable technological changes and job reorganizations.
- sex discrimination -- what is common in the wage and job structures of traditional industries is being recreated in the computer and information

industries. Over 95% of keypunch operators are women, over 60% of computer operators are women, but women account for only about 25% of computer specialists.

- job training -- in the eyes of many employers, older women have lived too long with old-fashioned technologies and will not be able to adapt. Special programs must be designed to bring the older woman office worker into the new office or to provide retraining for other valuable employment. National policy must address the legitimate needs of older office workers as well as the blue collar workers displaced in factories, for continued employment for the remaining 15, 20, or 25 years of their working lives.

Conclusion

These are some of AFSCME's basic concerns with office automation and possible directions for national policy in the near future. However, other immediate and obvious issues involved with office automation will probably grow in impact in future years. The increase in computer home-work, for example, will have a number of implications for the enforcement of labor standards. The ability to use satellites to transmit information from one office to another, in the U.S. or abroad, also has implications for employment in the U.S. I draw your attention to an article from the editorial page of last Thursday's Wall

Street Journal, the title of which speaks for itself - "Now we Can Move Office Work Offshore to Enhance Output". The author speaks in glowing terms of the tremendous cost-savings that can be achieved by transmitting clerical work overseas, in part because "there is a small but significant union movement within automated offices in the U.S.."

AFSCME has prepared a booklet for our affiliates who wish to develop a strategy to respond to technological change. The booklet contains examples of contract protections that we attempt to win in negotiations as well as policy statements adopted by AFSCME regarding technological change.

As a union, we are doing what we can, through collective bargaining and education, to help our members prepare for the jobs of the future. This involves, on our part, a recognition that technology can bring innumerable benefits, but also that it can impose very high costs on the individual and on society as a whole. The job of taming technology to be at the service of all Americans is a job that is too big for us, or any single organization, to handle. We need to consider the issues carefully, as a society, and to plan carefully, as a society, for a future that, for better or for worse, will transform the way all of us live and work.

I will be happy to answer any questions that the committee may have.

Let's turn to Mr. Cunningham at this point.
[The biographical sketch of Mr. Cunningham follows:]

PETER A. CUNNINGHAM
PRESIDENT

CAPABILITIES

- Fifteen years of consulting experience in the computer industry, including over seven years in senior management.

BACKGROUND

- With INPUT, Mr. Cunningham provides information services to executives and planning managers in the computer industry. He specializes in analysis and forecasting of major trends in the industry.
- Before forming INPUT in 1974, Mr. Cunningham was Director of the computer services department of Quantum Science Corporation.
- Previously, he was a founder and President of J. W. Goodhew and Associates, Inc., a Washington, D.C. data processing consulting company specializing in the Medicaid, association, and manufacturing industries, as well as the federal government. Goodhew and Associates was formed from Management Science America in 1970. With MSA, Mr. Cunningham was responsible for data processing projects in government and industry. Projects included EDP planning, systems design and development, and programming.
- Mr. Cunningham came to the U.S.A. in 1967 with C-E-I-R, for whom he performed systems development and management for American Research Bureau, the audience measurement research subsidiary.
- Prior to this, Mr. Cunningham performed system consulting in London, England after starting his career with ICL in 1964 in software development for the 1900 Series.

EDUCATION

- B.Sc. (Physics), Associate of the Royal College of Science, Imperial College, London, 1964
- M.P.A. (Technology of Management), The American University, Washington, D.C., 1970

Mr. **Cunningham**. Good morning. My name is Peter Cunningham, and I am president of a company called INPUT. We provide planning information to organizations that are vendors of computers, communications, and office equipment, and also to some of the large, aggressive, and competitive users of such equipment.

What I would like to do in the next few minutes is talk about some of the things that will happen rather than make judgments about whether they will be good or bad.

The first thing to recognize about the office is that it has a communications function. It takes in information, it processes information, it gives information out.

Also, when we look at an office, we should recognize there are three kinds of people. There are managers, professionals, and clerical, support, and semiskilled people. Office automation—which is actually a poor term to describe what are potentially major changes in the office—affects all of these people. INPUT prefers to look at office systems rather than office automation. Office automation implies the automation of existing functions in an office, whereas new developments in communications and computers in many cases, will effect the replacement of office functions.

Some of the things that will happen, of course, will be due to the tremendous growth of computer capability and use: Optical memory systems for computers, for example, will provide storage capacities that rival those of human brains and there are forecasts of as many as 35 million computer work stations in the United States by 1990. Personally, I don't like the term "work station." That is a station at which you work. I would much rather call it a "personal system."

There are similar changes in telecommunications. Ms. Lampkin talked about these and referred to some of the developments in satellite communication and in local area networks. There is rapid development in areas such as voice processing and image processing.

Today, many workers act as interfaces or barriers between other people and computers or communications systems. The direct processing of voice and the direct processing of image will remove the need for these interface workers such as operators of keyboards, typewriters, display systems, and telephone switchboards. Again the impact of development in computers and communications often will not be the automation of existing functions, but their replacement.

It is going to become cheaper to store and process information through a system than it is on paper. Paper is very ineffective, very inefficient. It does have some beautiful benefits, though: We can shuffle papers around on our desk and look from one to the other. That hasn't yet been duplicated in equipment. Paper is also easy to carry, and it does have a lot of other good attributes.

Essentially, one of the main problems of productivity in this country today—and most developed countries—is the explosion in the use of paper. We should recognize that in the United States last year, computers produced over 400 billion pages of paper. That is 2,000 pages for each man, woman, and child in this country. Each one of those pages had to be handled, had to be filed or stored. As we move into new systems, new optical processing systems and others, we will start to replace paper and, we hope, improve productivity and efficiency. The real impediment to improving productivity in the last 20 years has not been in manufacturing, it has been the increased office activity, particularly increased preparation, use, and distribution of paper.

There will be tremendous developments in software decision support systems, which could replace managerial decisionmaking in many cases. These will eventually grow to artificial intelligence activities, probably by the 1990's.

There will be a growth in services of various kinds—network services, data base services, information services. Many of these things are having an impact on the office environment.

The problem is, we are not looking at single jobs or single activities, we are looking at systems. That doesn't just mean clerical and secretarial people, it primarily involves professional and managerial people.

The impact of these developments on the people in the office is considerable. The first thing we think of is the impact on the clerical force. That is usually the easiest to address. Secretaries seem to be the most obvious targets. In fact, the real productivity improvements are going to be in reducing the professional, technical, and managerial expenditures.

Because of the support of systems, people at the lower skill levels will be able to take higher skill level jobs. We will start to see decisionmaking centralized again, a process that perhaps was more common 20 or 30 years ago. Support systems will allow companies to develop the good managers and professionals and get rid of the less able ones.

So although we hear constantly about the impact of automation on the clerical staff, the lower skill levels in the office, we may find that many of those positions will stay and that the professionals, the skilled workers, will be hit first.

Consider some of the things that are done in the professional environment in the office—for example, analysis. About $125 billion was spent in the United States a couple of years ago for professionals to do analysis. Much of their work was redundant. By using systems, we could probably do the work with half the manpower.

The telephone is also a very inefficient mechanism. As we get voice processing systems, we will improve our use of that form of communication.

Handling documents is a much bigger problem in an office than typing, for example. We think of office automation as being an attack on the typing function. Again that really is not where productivity improvements are possible. Productivity improvements are much more likely in the areas of handling analysis and documents.

One of the important things to recognize is that for many companies the factory is the office. Although there are office functions in manufacturing organizations, in organizations like insurance companies, Government organizations, and banks, the office is largely the production facility. It is in these information-intensive organizations that you are going to see functions replaced by technological systems.

One thing that has already been mentioned is the impact this will have on women because of their traditional role in the office.

There could be a negative impact, but there could also be a positive one because women will be able to move up the job scale using computers to perform new functions.

Essentially, over the next 10 to 20 years, we see the replacement of many office functions. If you look at the millions of people who are employed in those functions today, I think that you can say that those job functions won't exist or will be largely reduced in that period of time.

For example, in, the computer-aided design area, which is really an office function rather than a manufacturing function, there have been tremendous improvements in the productivity of engineers. One of the results is that, instead of performing manual tasks, drafting tasks, and repetitive tasks, engineers have been able to move up to meet some of the demands for new product development and product control in their organizations. This is due to the application of the same technology that will change job functions in offices.

The impact of office systems will be fairly significant. Today we have hierarchical, decentralized, and thoroughly rigid office structures, the typical pyramid. We foresee the pyramid disappearing. Essentially, the reason for the pyramid is to have communication between levels of workers. With computer communications network support, there are direct communication links between senior and junior employees, supported by staff functions. This is happening in areas such as sales and field support organizations. As a result, there will be a major reduction in organization levels in offices. A recent article by Peter Drucker said that that would probably be a very good thing.

Another factor that has to be considered is that, at the same time as we are making a lot of improvements on the hard technology front—that is the computer/communications, storage systems area—we are also making tremendous improvements on the bioengineering front. The reduced need for workers in many areas, plus the fact that we are correcting a number of terminal illnesses, plus the fact that we are attacking the aging process, may perhaps cause major employment problems—people looking for work and not being able to find it—over the next 20 years.

We do believe computer/communication systems in the office will replace a number of the functions, significantly reduce employment, and change the office structure.

Thank you.

[The prepared statement of Mr. Cunningham follows:]

Statement of
Mr. Peter A. Cunningham
before the
Subcommittee on Science, Research and Technology
of the Committee on Science and Technology
and the
Task Force on Education and Employment
of the Committee on the Budget

U.S. House of Representatives
June 14, 1983

IMPACT OF NEW INFORMATION TECHNOLOGY ON INDUSTRY AND SOCIETY

In this presentation today I will look at not only some of the new technologies that are coming into fruition in computers and communications and their impact on industry and society, but also at the application of existing technologies in new ways. I will deal with products and services which are at least in the experimental or development stages. I will not speculate about technologies that have not yet emerged.

However, even if we do not know the exact characteristics of technological products and services in the computer and communications area, we can make some predictions about what their performance will be and, hence, derive some conclusions about future impacts. This is particularly true in areas such as artificial intelligence and man-machine communications, including voice and image processing.

In considering some of these issues, we immediately realize the importance of developments in the "soft" side of technology, i.e., software, data bases, and education course material. We may not classify software itself as "technology" but we all recognize the vital importance, indeed the necessity, of software. In fact, it is the device or structure which applies the power of computers and communications to the tasks that humans face in their business, government and social activities. Thus, we will have software which is affected by, and participates in, new technological developments. Also we expect to see developments in software itself. These will include new languages, new application development methods, and new communications software.

One certain development over the next decade is that the boundary between hardware and software will change. Indeed it has already. It is now no longer a rigid line but it is a grey area which varies by type of system. The general impact of this fluidity in the hardware/software boundary will be an improved price/performance for the user. For regulators, market analysts, and those companies which wish to emulate or interface with other systems, this process is going to increase the complexity and difficulty of their tasks.

In this presentation I will talk about some of the functional impacts of technology developments. From this we will talk about the impact of known or foreseen developments on certain key industry areas. In both these areas we have a considerable amount of data and research information on which we can base the items presented here today.

In the next section of the talk, however, that on the impact of computer/communications technology developments on society, we have less hard information. Studies have been done in a variety of nations, including France, Austria, United Kingdom, and I am sure in Japan as well, on some of the future impacts. Often these studies are politically motivated and oriented. Their results must therefore be interpreted accordingly. It is an area where there is a great need for more independent research and open discussion among the general population of the implications of the coming developments. In the concluding minutes of my talk today I will mention some of the impacts at the national level which I believe are important.

INTRODUCTION

Let us start, then, by considering this third social revolution which is supposed to be upon us now. After the agricultural society, we had the industrial society and now we are supposedly moving into the information society. But what does information really mean in this context?

Perhaps we are better able to understand what is happening if we look at the engineering changes upon which these revolutions were based. In the agricultural to industrial change, we essentially had mechanical and civil enginerring developments, including the use of the steam engine.

Following that in the industrial revolution we had the age of the electrical engineering developments. Electricity gave us power and telecommunications. From the roads and railways and canals which gave us physical communications in the industrial period, we then moved through electrical means to remote communications among individuals thousands of miles apart. This change encouraged the rapid spread of ideas which accelerated the change in our industries and societies.

Now, in this new revolutionary stage, we are really looking at electronic engineering as being the prime motivator, and indeed, we could regard this as an electronic revolution. It is the application of electronically based devices, sometimes combined with magnetic or optical systems to almost every aspect of our lives.

In order to understand what is happening in this revolution we must recognize that there are three attributes to be examined. The first is that of discovery. Today we have research going on, not only in computer communications, but also in bioengineering, energy and finally in space. This last is extremely important. In my opinion, the fourth social revolutionary period will be that of the space faring human.

In this discovery stage the role of electronics is absolutely fundamental.

The second characteristic is the application of the discoveries to industry, the economy, and society. Of course, this is the area that we will be addressing today. The third characteristic which we shall touch on towards the end of this speech is that of order. Here we must recognize that there is always resistance to change. This resistance may be expressed as inertia. Often, in the face of change, human societies experience breakdown of established patterns of behavior which may result in violence. Out of this breakdown rearrangement produces a new order.

What, then, are some of the new developments that we expect to see impacting industry and society in the next ten to twenty years?

First among these must be developments in communications. Satellites, of course, are here. They are being used for broadcasting, voice communications, data communications and message handling. They are being used for weather forecasting and spying. In the long run they may be the most potent weapon in the breakdown of our national cultural boundaries.

Secondly, of course, are new transmission media, particularly those which allow wideband transmission. In the United States, full scale video teleconferencing is beginning to emerge. Centers operated by telephone companies are becoming commercially viable and many large companies are installing their own video conferencing centers.

Here I should make the point that the concept of "picture phones" if you will, has been with us already for 20 to 30 years: it may be another 20 years before they are in widespread acceptance. In other words, the delay between an innovation and its widespread acceptance, in this case, may be as much as 40 or 50 years. We must recognize that this is common. Many of the things that we think are happening very rapidly such as radio, television, home appliance computer acceptance, in fact, take a minimum of 8 to 10 years and often 20, 30 or 40 years to be fully accepted. Society simply does not change as rapidly as some people would like and most of us are grateful for this natural inertia which allows people to assimilate new products, ideas, and concepts.

The third communications area which we believe is vitally important is the whole concept of local area networks. Local area networks today are generally thought to apply to office buildings, manufacturing, or educational complexes. In the past, however, they have often referred to local community communications, which are now being established to a certain degree by cable network. Thus, you have the wired cities in France and in Japan as well as a number of experiments in the United States and other countries.

Whether you regard a local area network as being extremely local within one building or spread through a local community we must recognize that this cableing together, if you will, of our business and home establishments is again going to have a very fundamental impact over the next 10 to 20 years.

Two areas that, then, are strongly related to this telecommunications activity are voice processing and image processing. With voice processing we can expect to reduce our reliance on keyboards. Keyboards slow down the interface of the human and the computer communications systems. This is especially true when one individual (a manager) has to communicate with the computer communications system through another individual, a typist, secretary, or CRT operator, who is an expert in running the keyboard. This inefficiency is one that we can expect to see rapidly replaced in the next 10 to 20 years.

Associated with voice processing is also image processing, not only for static graphics like slides and charts but for pictures, moving or video pictures, and animation. In this last regard there are some areas with which we must take special care from a social point of view. For example, there is at least one system today which can take the features of a human when absolutely still and digitize those features. Using software algorithms which are analogous to muscle structures in the face, this stored image can then be animated. Combined with sophisticated voice processing equipment the individual can then be brought to life as it were on the screen. At the very least, this may in future remove the need for live artists in many of our movies. It also raises the possibility of a dead politician being kept artifically "alive" through this process.

Other changes we can expect to see in information display include new ways of presenting information graphically, interspersing video and other material. A particular change in information display which will be welcome by all of us except for perhaps CRT manufacturers, is the advent of flat screen technology. At least one company in the United States expects to have a flat screen display system available for computer output within a year at a comparable price to a CRT and with better definition. This is particularly important because there is growing concern about the problems associated with long, repetitive periods viewing CRT screens.

Other improvements we expect to see in processors and in storage media are going to dramatically change price performance of computer systems. We expect these changes to continue to occur over the next 10 to 20 years. We do not see a flattening out here yet. At the small end, we expect to see, for example, within the next 18 months, a 32 bit processor at the personal computer level which will actually process the IBM 360/370 instruction set.

Which brings us to the subject of software. The current application software development process is, as many of you will recognize, like a dinasour. Like a dinasour, it will hopefully become extinct. Already major changes are being made in the ways that companies develop their applications software. We have moved from assembly language programming to COBOL and now to higher level languages of various kinds. However, it is not in the programming that we expect to see the real improvements, but primarily in the interface between the users and the systems designers and developers. The gap between the user and the computer technologist must be bridged. This will be done by providing software which will help this interface process and also eventually allow the user to develop all the software necessary for his own internal functions. The role of the designer will increasingly be to ensure compatibility and conformity across the various users that constitute a business or government organization.

I believe of particular importance is the development of the services business, not only computer services but also communication services and the rapid growth in networks, particularly of data bases. If the data contained in these data bases has value then the spread of this data through the growth of on-line data base systems surely will contribute to improved performance of industry, business, and government. Particular areas of data base activity which are growing rapidly are news information and, in the United States, credit information. Incidentally, this spread of news information being provided through communications networks is very important when you consider also some of the developments that we mentioned earlier in telecommunications. A concept not only of national newspapers but of truly international newspapers including a world paper, if you like, is now quite feasible. Already you see papers such as the Wall Street Journal publishing Asian editions and probably in the future a European edition.

I would like to spend a few seconds talking about the concept of artificial intelligence. This ultimately will have the most impact on our society. We must make the assumption that at sometime in the future computers will be smarter than humans. In military systems, computers already out perform humans in terms of the operation of attack and defense systems on board airplanes, for example. In the area of investing, a number of organizations in the United States rely more on computer programs to make their investment decisions than they do on people. Initially these machines will be more competent than humans in only a few areas. But, over the next 20 years the number of these areas will expand dramatically. In parallel with this sheer development of specialized intelligence capabilities we also have the coordination and motor capabilities or robotics. We could ask the question, will a robot ever win Wimbledon? In my mind, that is the wrong question. The real question is when will a robot win Wimbledon, always assuming they are allowed to enter? This might take 50 years to 100 years, but undoubtedly at some time in the future these systems will not only be brighter than humans, but in specialized tasks they will also be physically more competent. A sobering thought.

However, it is precisely the kind of thought that many of us do not want to think. These are problems that are avoided. I believe we have a responsibility to address these issues before they are upon us.

You also then have the intriguing postulate, raised often in science fiction, of robots or computer systems indulging in procreation. This has started to move out of the realm of science fiction: a program at Stanford University has recently designed an electronic circuit.

The social implications of this thought process are incredible.

I recently had occasion to talk to one of the pioneers in the bioengineering field. In fact, we served on a committee togther. I mentioned to him that I had once been asked by somebody at IBM what would replace electronic computers and had replied, "biological computers." To my surprise he mentioned that there were people already starting to work on this very area of development. When, where and how they will appear, and what they will cost, nobody knows. However, we can be sure that speed capacity, and reliability of systems will continue to improve in the foreseeable future.

What about the information age, that is supposed to be emerging? The conventional wisdom is that we live in an information economy and that information markets are growing at explosive rates. Like electric power the outlets for information will become widespread in homes and businesses. However, the reality is that embedded methods and behaviors will have to change and that this is a very slow process. Also, we see in the process some quite different changes to what we would expect. From 1975 to 1980 in the United States, the growth in personal consumption expenditures for information was actually almost half the growth in all personal consumption expenditures. In other words, the expenditures by people for information actually shrank as a total proportion.

On the other hand, information expenditures by businesses exploded by 100s' of percent. It turns out that people use more information but as individuals they found this information subsidized by businesses. Banks, broadcasting companies, newspapers all provided information subsidized by other means, such as advertising or, in the case of banking, deposit balances.

Certain information services areas are starting to grow. The provision of news information and other kinds of data through networks such as those operated in the U.S.by Dow Jones, Micronet, and The Source have grown rapidly in just a short number of months. If we also include Prestel and The New York Times we find that the number of subscribers from June 1981 to March 1982 went up by 86% which is 128% annual growth rate. Similarly, the growth of personal computers is extremely rapid. From 1980 to 1981 we had the phenomenon of personal computer sales by 7 major manufacturers in the United States being larger than their 1980 base. There was 107% increase in the base of personal computers from these manufacturers from 1980 to 1981.

Of course, many of the on-line information service users and users of personal computers are not in the home but rather are in businesses, particularly in large organizations.

Not only do we see very rapid growth in the numbers of personal computers but also in terminals. As a result of the growth in numbers of these devices, by 1986 over 15% of the U.S. work force will have daily access to computers compared to about half that amount today and less than 2% in 1976. We must be careful not to simply add numbers of terminals and personal computers to get total number of people with access since many individuals, again, particularly in larger companies, may use 2, 3, 4 or more devices in their local area of business to access a computer. We must recognize that this ubiquitous growth of computers is as important as the growth of individual telephones was many years ago.

We are following the traditional curve, the S curve, showing the adoption of new products. The one shown here is that of the adoption of television sets from 1946 to 1969. The similar pattern is now being followed for personal computers and terminals.

FUNCTIONAL IMPACTS

The key area that computer communications developments will affect this decade is that of the office. In order to understand fully the impact of these new technology developments, we must recognize that the office is a communications processor. The office takes in information, it processes the information and then it passes it along to other offices, either within an organization or external to the organization.

In order again to have a proper perspective on the office and the application of new technology we must recognize that office systems in the future will replace and change office functions. They do not simply automate them. Most people today are concerned simply with office automation, that is the automation of existing processes. True application of new technology in a systematic way will change the function of offices. The classic example of this is the order entry function in a fairly large company. Instead of orders being sent in by mail,or called in over the telephone, in future orders will be placed directly into a computer system from terminals at customers or salespeople in the field. This process does not automate the order entry office, it simply replaces the office.

An analogy is what happened to telephone operators. In the early days, callers called into an operator who then literally plugged the telephone line from the caller to the person being called. By applying systems to this process, the plugging function was not automated, instead the routing capability was given to the caller by putting dials on the telephones.

True productivity improvement in the office will not come through automotion but through the application of systems to office functions.

This emphasis on the office as a communications processor is increased if we examine the distribution of office product and service expenditures. Here we find that over

60% of such expenditures are directly related to communications through mail, voice and message.

So what technology developments will impact this area? Firstly, that of voice processing. We already see store and forward systems being offered. In fact, American Express in the United States is offering a voice store and forward system to the consumer already. We also see the growth of computer aided teleconferencing and of video conferencing. Computer aided teleconferencing in large companies will be used by over a third of them by 1985. According to a recent survey that INPUT performed, over 40% of large companies will be using video conferencing by 1985 compared to about 10% at this time, most of whom are experimenting rather than using it on a full production basis.

Perhaps most important are the developments in image storage and processing. Companies in Europe, such as ZEISS, the United States and Japan FUJITSU, HITACHI are all experimenting with or introducing image storage systems. Particularly as optical disk systems become accepted and acceptable, we will see the cost of storage of images on the electro-optic systems or electro-magnetic systems becoming less than that of paper. The cost associated with handling paper are enormous. Not only does the paper have to be bought itself but also you have the filing, storing, sorting, retrieving, and routing costs of paper to contend with. Within the next several years we expect that the cost of storing a page of information on new systems will become less than the full cost of storing such information on paper. At that point we will start to see a major change in office systems take place and a tremendous increase in the use of computer based systems.

As a result, in the United States, we expect to see paper use related to computer information output flatten out in the time period 1984 to 1986 and then start to decrease. The use of computer output microfilm will still grow over the next few years but then will start to decline even more sharply.

The amount of paper produced by computers is absolutely staggering. In 1981, over 400 billions of pages were produced in the United States by computers. Each one of those pages had to be handled, many of them filed, some of them destroyed. We absolutely expect that over the next 10 years new technology developments will dramatically reduce paper use. In this regard, we should note that this is contrary to what many of the manufacturers would like to have happen. They make for us printers, copiers, and other devices whose sole objective in the last 5 to 10 years seems to have been to produce more paper faster. Systems designers everywhere have fallen into their trap by producing many more copies and pieces of paper than are necessary. Most organizations could achieve major increases in productivity today simply by reducing the numbers of pieces of paper produced in their organization.

If current and foreseeable technologies are combined and applied in offices in the years leading up to 1990, we would expect to see the equivalent amount of output produced by today's office workers produced by only 60% of the current work force level. The major impact will be in the professional and technical area. This will be slightly ahead of the clerical, secretarial area. That is not to say that the managerial level will be unaffected. In fact, the managerial and administrative personnel may be unpleasantly surprised because many of the professional and technical people and some of the clerical people displaced from their tasks may be able to handle managerial and administrative tasks when properly supported by computer communications systems. Thus, we expect to see a flow of personnel across the boundaries. Out-of-date managers simply will not survive.

If we examine how the professional and technical staffs would improve their productivity, we find that one of the major areas of inefficiency in today's office is that of meetings. In our opinion, current meetings are 75% replaceable using computer communications technology developments such as computer aided teleconferencing, electronic mail, and video conferencing. We also see increased efficiency in telephone use. Another area for improvement is analysis. In most companies, the same issue is analyzed over and over again by different groups and reports are stored and filed away. Simply having access to this information through electronic files will reduce the need for repetitive and redundant analysis. We must recognize that professionals and technical personnel will resist the application of computer communications storage and handling techniques to their areas of expertise for job protection purposes. The classic example of this is the resistance by computer systems developers, programmers and designers to using new tools which will make them more productive.

In the clerical and typing area, the major reduction will not be in typing. This is the tremendous myth of the office. The major reduction will be in document handling, getting rid of the "paper jungle: that exists today. The support functions of the secretarial and clerical force will be affected by voice input and voice processing systems, as well as by electronic document handling.

These changes, particularly in the clerical and secretarial area will not be without significant problems. Major redundancies in these areas, could well bring increased unionizaton. This is particularly true since the office has been a major area in which women in the industrial world have the entered workforce in the last 30 to 40 years.

In the management and administrative area, the major impact will come from decision support systems. This is not so much a technology development as a software development, including availability of internal and external data bases. Decision support systems will increase the efficiency of managers in making decisions. The systems will reduce the time decisions take, and will reduce the numbers of people that need to be involved in a decision process.

An individual may be able to handle 5 to 10 times as many decisions as he does today. As a result, we can expect to see some of the levels of management be removed from organizations. This has already started to happen in some sales organizations in the United States where through electronic mail and other communication systems information can be moved from the field to management and vice versa more effectively than through intervening managerial levels.

Decision support systems will eventually migrate into artificial intelligence systems, whereby computers will make the decisions. Initially, these will be provided in the form of advice to humans but then subsequently the machines may well give direct orders or directions to humans or to other machines.

A consequence of this change in management capability, and of the increased use of computer communication networks and data bases, may well be a swing back from decentralized management to centralized management. We already see examples of this. One classic example is that of cash management. In the past this has often been done on a narrow geographic basis for large multi-national companies. Today it is increasingly being done on a worldwide basis by one room which looks, in ma[illegible] cases, like a war room with computer communications links to banks and other financial institutions on a worldwide basis.

If we look at some of the specific products that will affect the office and office related activities over the next 10 years, the most important ones are in the personal computer, executive system, or work station and image processing areas. If we look at the personal computer we notice one quite new phenomenon. Initially personal computers were used in business to do typically "spread sheet" analysis and other forms of minor data processing tasks associated often with finance and accounting. These are still the major application areas for use of personal computers. However, coming up fast is the use of personal computers for word processing, report and work generation and administration. We project that these types of applications, the office related applications, will rapidly over take the traditional data processing applications on most personal computer use in business, industrial and government organizations. The personal computer is an extension of the individual's activities. These systems are not being used so much to replace existing data processing activities but to add a new level of computer activity, small applications that have not been done before on any kind of cost effective basis on large systems.

Another major role, and one which is often under estimated, is the use of personal computers in education and training. All individuals in an organization should be constantly undergoing education and training. However, for many of them it is difficult, and in the past, it often required a special set of times for classrooms and conferences and seminars. Now, through the use of personal systems, particularly when they are connected in future to video processing systems, all workers at any level can go through this learning process in a much more acceptable manner.

The personal system, often called the workstation, should be the focal point of regard in the office of future. It is the largest potential market. However, we must recognize that the personal systems needed by professionals are vastly different from those needed by administrators and managers and in support operations tasks. The most complex systems, but the ones used most aperiodically will be for professionals.

The personal computer will become the hand held computer.

These also will be ones that would require most analytical capability. On the other hand, support and operation systems will require the capacity to do a relatively few tasks on a continuous basis.

One major problem we should mention here with regard to the application of new technology is the fact that in most organizations, only relatively few of the functions in equipments are actually used. In the decision process, many functions and features are weighed which are subsequently never used. This is a tremendous waste of resources and money. Another piece of advice that we would have for most organizations is to use the simplest product available for a given task provided it can be expanded when necessary in the future. Managers, for example, will not use a lot of functions. They will use a limited number of functions, many of which have been preset by their professional staffs.

In communications we expect to see current communications facilities dominate for the 1980's. Local distribution alternatives and long distance transmission vehicles, other than satellites, are still in their infancy. Telephone companies control access to communications networks and will continue to do so. In many countries, telephone companies are either part of the government or are strongly and tightly controlled. Recently there has been a move to free the communications environment which should allow for more rapid change than we have seen in the past. Some idea of the scope of the possible changes may be gleaned by considering what would have happened to the computer industry if it had been limited in the same way that the telecommunications industry has been limited over the past 20 years. In fact, if we look at those countries where the computer industry is, and has been limited in the same way as telecommunications, we see that they have gone absolutely no where compared to those countries where the computer industry has been market driven.

—DEREGULATION
UK
USA
JAPAN

Having said all this it is certain that within the next several years the costs of telecommunications will increase dramatically to the end user. As a result we are going to see computer-communications trade-offs. We are also going to see an explosive growth in the use of products to control communications costs, particularly when we consider the dramatic growth in the use of on-line systems. This will be about 40% per year in the United States. In many companies communications costs related to computers may soon exceed their computer equipment expenditures.

When we look at opportuntities we see that there is a tremendous need for the sharing of information within an organization, between companies within the same industry, and then between companies in different industries, such as retailers and wholesalers, or manufacturers and wholesalers.

New communications use will start fairly heavily in the inter-industry area. Already there are data bases of products which are being used to interface manufacturers and wholesalers. Other interfaces are between retailers and banks.

We must also recognize that 80% of all communications today occur within a building and a complex. Only 20% are interbuilding. Thus, we could expect to see a major focus by companies on intrabuilding communications.

As I have mentioned, the whole area of intra-building communications and encompassing local area network will expand dramatically. Store and forward systems, data, text, voice and image are already appearing and will be applied first in many cases on an intra-building communications basis. These will require very intelligent digital communications control systems, which may well be array processors.

We also expect to see a major use and growth of communications services, particularly those providing interface between communicating word processors, terminals and personal computers. The whole area of interfacing dissimilar products and terminals is becoming a major problem within organizations today. We have in many companies Towers of Bable emerging which must be counteracted if we are to make progress.

↑explain. ↑ like nationals.

I mentioned earlier that within offices computer aided teleconferencing and video conferencing is already making its appearance. These may well be done within complexes as well as, particularly in the video conferencing case, across national or international distances.

IMPACTS ON INDUSTRY

We have spent a lot of time considering the general technological environment and some of the changes that may happen in computers and communications. I would like now to address some of the impact on industry, starting with manufacturing.

Manufacturing has already been heavily automated. However, this automation will continue primarily through computer aided engineering and manufacturing. What we see happening today is that the traditional separation between the design elements of a manufacturing company and the production elements are beginning to disappear. Increasingly, we are looking at an organization which rotates around a corporate manufacturing data base which is fed by design and manufacturing processors. In the CAM area, in particular robotics, the application of computer systems, particularly to the handling of materials and some of the more dangerous and difficult tasks in manufacturing will be widespread. If we look at the total market for CAD/CAM we see that in 10 years, from 1980 to 1990, user expenditures for CAD/CAM products and services will go up by a factor of 20. Through the 1990's this will continue to accelerate as we have more and more use of robotics not only in materials handling but also in manufacturing applications. We see that up to 40% of the existing work force in the manufacturing area is replaceable by existing technology. Some projections have been made that 50% of workers in the factory in future will be attending robots: they will be field service technicians. These robots will replace welders, assemblers, machine tool operators, painters, etc. Notice should be made that these robots initially will replace the semi skilled workers, particularly, not so much the unskilled.

This is a phenomenon which must be understood for the future. Computers and communications devices and systems will affect the semi-skilled and lower skilled workers much more than they will unskilled workers. You will probably, from a cost stand point, still have humans cleaning factories where the skilled functions being performed are automated. As we shall see later this is the stretching out of society from the top to bottom which must be addressed unless we are to have some very rigid hierarchical classes established. The new skilled, of course, in this process, will be those that not only attend the robots but initially guide and direct them. This is before artificial intelligence gets to the stage when even that function will gradually become automated.

In the process control industry we already have a very automated situation. This is one of the most capital intensive of all industries. We foresee little labor displacement in this industry by computer communications techniques over the next 10 years. On the other hand, there will not be a growth in employment, but we will have processes changed and become more dynamic with existing or slightly smaller labor forces.

In the area of computer aided design, particularly we are seeing productivity increases of a factor of 4 to 10 using CAD systems. Not only do we have productivity increases, but we have shorter life cycle products. We can expect to see products that in the past had a life cycle of 5 to 10 years now have a life cycle of 3 to 5 years and eventually may reduce to 1 to 3 years. In fact, the limiting factor on the life cycles will not be so much design and manufacturing, but will be more distribution, and particularly, the problems of field service and support. Within the computer industry itself you have seen the life cycle of computers reduced from 7 to 10 years now down 3 to 5 years. One of the things that is placing tremendous pressure on computer manufacturers is this real situation of the speed-up of design manufacturing process allowing new lines of products to come out every 2 to 3 years. We believe that this is a process that has not been fully understood or appreciated yet.

Along with shorter life cycles we also expect to see quicker introduction of products, faster turnaround, and response to market conditions. This is going to accelerate the competitive problem of many companies. They are going to need these computer communications networks in order to stay competitive. This will particularly impact medium size companies that are too large to have the quick reaction time of very small organizations and yet are not large enough to have the sophisticated computer communications capability of the very large companies. This is especially true when you consider that these very large companies, if they apply the new technology developments properly, will become much more efficient and streamline their decision processors.

We can expect to see more specialized and custom products. Indeed, in the computer industry itself, we expect to see computers eventually being made to order, as it were. Along with this, of course, we expect to see smaller production units.

Hopefully, we will receive higher quality and safer products. We know that CAD techniques have been able to improve significantly the safety of automobiles. This is extremely important for manufacturers who will be required to have fewer warranty concerns. This is in view of the variety of products that we can expect to see from any one manufacturer in future. Maintaining, supporting, and diagnosing the increase in the number of products will pose very real problems for many manufacturing organizations. This is especially true if government agencies require them to keep records for safety purposes of their products.

We can, of course, expect to see less waste in production and in inventory. We can also expect to see more efficient products, particularly in their use of energy. Design techniques, including simulation, applied to electric motors and other electrical systems are rapidly producing more energy efficient products.

In the distribution industry, we will see a secondary impact rather than the primary impact within the manufacturing area. Yes, we will see better inventory management, we will see fuel efficient delivery, and improved logistics. Quite importantly we expect to see production sites optimized for the material-transport-production-transport-retail cycle rather than the centralization we see now. In this regard, certain elements of the chemical industry and paint industry in particular in the United States have actually decentralized production sites because the cost of distribution has started to become a much more significant factor than the cost of manufacturing.

Another factor here is the question of the potential elimination of distributors and traders. With computer communications systems will you need distributors? As we have seen in the United States in recent years, many companies have tried to go direct to their consumers. In fact, Texas Instruments, IBM, DEC and others have set-up retail establishments to go direct. This has not always been successful, largely due to the antiseptic nature of most of the computer stores established.

The one real reason that distributors and traders will continue to exist in our opinion is their ability to intrface with the customer and provide the customer advice, consulting, if you will, and field service. We can not emphasize enough the importance of field service activities in all aspects over the next few years. Already, field service expenditures represent 25% of the life cycle costs of some large computer systems. Moreover, the customer is increasingly going to be making decisions on the basis of support, since the products from which he is able to choose will be hard to differentiate in terms of their fundamental characteristics. This again is a result, as we mentioned earlier, of the growth of computer communications capabilities and the abilities of manufacturers, therefore, to respond to changing market and competitive conditions quite rapidly.

Indeed the whole area of information brokering for companies such as a brokerage companies, real estate companies, travel agencies and trading companies must be examined carefully. If an organization is simply brokering information then we have to consider that organizations on either side of that broker may choose to go direct. Travel agencies, for example, could potentially be replaced by airlines or other organizations providing travel information directly to consumers and businesses and providing the means by which those consumers and businesses could then order their travel package. Retailers, such as Sears, are already in this business.

However, again, in our opinion, the customizing capability of these information brokers and their ability to consult with the customer will ensure the survival of some, if not many, of them. But they are going to have to significantly change their work processes and become much more competitive and much more customer oriented if individual organizations here will survive.

Some examples of the kinds of services integration that will be possible in the future are contained on the next few slides. These are about U.S. companies because they are the ones that I happen to know best. We can see that Control Data Corporation has made some fairly major adjustments in its provision of services and integration of services to businesses. Through its Commercial Credit organization it will provide computer and office products, information processing services, training and consulting, financing and insurance to businesses through a network of literally thousands of offices nationwide. The distribution point for these services will be local to the small business. Similarly Citibank is integrating financial services, investment, insurance, credit, loans and checking to consumers. Citibank is not alone in this process although it is one of the leaders. One of the most intriguing companies in the United States to watch has been Sears. In addition to providing goods to consumers, they now also provide insurance, cash, credit services, investment services, real estate and travel services. Sears is becoming a distribution vehicle for a multitude of services besides just products.

Here we see some classic examples of companies crossing industry boundaries. This crossing of industry boundaries is made possible by the computer communications networks that they are developing. All the companies that I have mentioned are leaders in their application of computer communications developments.

Returning now for the moment to the question of support, again I would like to emphasize its importance as we see increasing use of systems like remote diagnostics, allowing a consumer or a commercial organization to connect into a network to have a product diagnosed. Even in the automobile business, we now have service functions where automobiles can be driven into a diagnostic center connected to a computer and the diagnosis made of the problems. Many products, particularly in the home, cost more money now to maintain than is economically worthwhile. As a result, many products become disposable. We may well find manufacturers turning to the concept of self maintenance where instead of having a box which simply cannot be opened by the user, it will have a diagnostic capability built into it and the ability for the user to pull out and put in the boards and other devices to maintain the product. We may well find this technique applied in stereo systems, as well as in computers and other more expensive equipment.

Self-installation and self-instruction are both becoming more important. We know of one very successful software company, for example, that never makes a call on a client. All sales, installation and support activities are performed using video tape, telephone, and self documented processors in the software.

In the future, some of the major changes will impact professionals through artificial intelligence. In medicine, we already see diagnostic systems that can compete with physicians in terms of their effectiveness. A program call Internist I from the Massachusetts General Hospital in a test against physicians and reviewers recently performed about as well as the General Practitioners in the hospital. This was with the data base which is probably reckoned by its researchers to be only 70% complete. Also, the system can not yet distinguish the severity of an illness. However, it is the first working diagnostic program that can compete with a physician.

In the legal area, you already have programs written that will write wills, complete income tax returns and serve as expert consutlants.

In the future, of course, we have to face the probability nay the certainty, that at some point computers will be better able to make judgements in criminal and civil cases than humans. This is simple because they can take into account all the legal nuances and factors invovled. Also, they will not be swayed by emotion.

For engineers themselves, computer aided design systems have already had a major impact but what happens when artificial intelligence allows systems to develop a better product, one that is more responsive to market conditions or other factors, than can be developed by humans? As I mentioned earlier, we already see a circuit designed by a computer program.

One aspect of all these artificial intelligence applications that will grow very rapidly is the whole area of legal responsibility and ownership. In fact, we may well see more lawyers working on the results of artificial intelligence than are replaced by artificial intelligence developments.

Other expert systems described recently in an article of the Wall Street Journal include air traffic control systems. As we all know, air traffic control is one of the most strenuous mental activities in a professional environment. Similarly, fire fighting systems, security systems will be developed. Honeywell, for example, has a security system which, through sensors of various kinds, detects motion related to intruders within the buildings.

With image processing systems, it is only a matter of time before security cameras are connected into data bases of images of known criminals to match bank robbers, for example, with stored characteristics to identify them. Ultimately, a camera and a computer system may well be more cost effective than a policeman on the beat to detect criminal activity. This may well free up the police for more investigative and analytical work as well as more community support. Complex systems management is already being performed by computer systems particularly in the areas of power distribution, electric power distribution, and, of course, the war systems on board military aircraft and vessels of various kinds.

The implications of these developments are obviously lead by cost. Computer communications systems which are initially much more expensive than humans will then over a period of time become cheaper, particularly if labor costs continue to increase. As we said earlier, because of the cost implications, skilled functions are more likely to be replaced first rather than unskilled functions. Another implication, of course, of the growth in the use of these systems use, is the the change in skills that will be necessary within organizations. One example we mentioned earlier, was the need for attendants for robots in factories in the future, a whole new job area being created.

A major implication is who will be responsible for computer communications systems of the future? If a computer invents a new design, who owns that design? Is a computer's invention patentable as The Wall Street Journal asked recently.

This brings me to an aspect of the future development which I find very intriguing. What happens when we start to combine developments in bioengineering and telematics, the word describing computer communications developments?

I believe we can assume that some time in the next 20 years, the aging process will be identified and at some time, perhaps in the next 50 years, it may well be controlled. We will also have terminal illnesses controlled, such as cancer and heart disease, through improvements in bioengineering and other medical science activities. Combine these two processes with the reduced need for workers because of computer communications developments and I believe we have some very serious questions. Again, I want to emphasize, that in my opinion it is not a question of will these things happen but a question of when. I believe they will certainly happen within my children's lifetime and may happen within my lifetime.

In Europe, North America, Japan, and similar countries, life expectancy has increased rapidly, up to 60 or 70 years and has stayed relatively stable. In some countries, it has started to decline because of problems related to pollution, heart disease, smoking, drinking, etc. Yet, we can perhaps in the next 50 years expect to see the life expectancy suddenly grow very much more rapidly to quite large numbers.

So what kind of conditions do we have that would be addressed by these developments? First of all, the welfare and social security systems in many countries, particularly in the U.S. and the U.K. with which I am familiar, are virtually bankrupt. They simply could not absorb an increase in older people or people out of work on the scale of what may happen when the developments I mentioned a few minutes ago actually take place. On the other hand, we have the situation that the average work week has stayed stable in the U.S. over the last 30 years it decreased from something like 67 hours per week in the 1800's to about 40 hours a week during the 1950 timeframe. We also have the phenomenon that the work force is aging fairly rapidly in the U.S. The same thing is occuring in Japan. One result of this is that in the short term we actually may have a shortage of people available for the work force. This will rapidly change in the latter part of the next two decades. This brings us to a discussion of the impacts on society of computer communications developments and here I should say we have much less hard data to deal with.

Continuing our discussion on employment, we will have structural, technological redundancy which possibly may be up to about 20% in the U.S. within a generation according to some economists. However, some people still predict we will have a labor shortage in the next 10 years.

Some other things we need to consider is that when we look at employment, government expenditures, at least in the U.S., are largely tranfer payments. In some countries, like the United Kingdom, a large portion of government funds goes not only to transfer payments but also to keeping obsolete and obsolescent industries functioning.

One approach to the problem of employment is to have large projects. Now, in the past, these large projects were the building of such artifacts as canals and railroads in the 19th century. Then, in the 20th century in the U.S. we built highways, dams, and hospitals. These and defense activities have had enormous employment ramifications. Transfer payments are taking up such a large portion of government funds that we actually have highways, dams, bridges, etc., starting to decay. In the latter part of the 20th century and 21st century, the only area that could provide anything like a large employment program could be the construction of space artifacts, including the moving of industry and people off the earth.

There are some alternatives that can be looked at in terms of employment. A study done in Austria and published in 1981 looked at various scenarios for the Austrian economy through 1990. The Austrian economy as mentioned in a recent edition of Scientific American is about 3% the size of the U.S. economy. But, it is an industrialized country. The scenario with full mechanization in 1990 and a 40 hour work week shows the highest GDP and wages per capita but also has the highest unemployment. A second scenario which has of full mechanization but reduces the work week from 40 hours to 35 hours shows a smaller GDP, and less wages per capita, but the unemployment rate is only 2%. A third scenario, uses a 40 hour work week, and keeps mechanization at 1980 levels. This has unemployment at 7%. This analysis may or may not be realistic, but it does show some of the trade-offs that can be made. The question becomes how can a government choose among these scenarios? Then, what specific actions can it take to implement that choice? With the current state of econometric theory and practice, I do not know whether these actions could be properly defined.

The conclusion is inescapable. It is a disservice to the general population to tell them that they can expect full employment over the next 20 to 30 years if computer communications developments are to be fully implemented. On the other hand, if they are not implemented, you may well get unemployment because industries become non-competitive. This, of course, is classically seen in the United Kingdom.

Moving from the fundamental aspect of employment to some other other areas of social activity, you will find that business travel will be significantly reduced. In addition, we may start to see local offices rather than the very large central offices in urban locations. Offices can be fragmented into specialized groups connected by computer communications networks. I do not believe offices will be replaced. Man is after all a social animal and requires a place in which to meet peers and have a human interface. However, monstrous offices employing thousands of people in one location will probably become obsolete.

Another activity that we all indulge in is buying. We will expect to see greatly increased use of home purchasing because of the growth of computer communications networks. These networks will replace catalog sales in the home, particularly when we can get full screen video capability combined with computer purchasing mechanisms. We are really a long way from this prospect at the moment. The home electronic purchasing networks established so far are very rudimentary and do not include anything like the necessary form and features to have a successful use by the general population.

On the other hand, we will see use by relatively small groups of people in very specialized areas. For these people, special services will be introduced that will be commercially viable and successful. After all, with hundreds of millions of people in the consumer markets you only need a small percentage that are attracted to a given type of a home retailing system to make it commercially successful.

One phenomenon that we are seeing now is that of intersector trade-offs. People are buying video recorders instead of automobiles. In fact, in Italy, one of the major reasons they decided not to go to color television at one point was because of the projected impact of the purchase of color television on the Italian automobile business. As a result, color television stations and sets were banned. To show how ridiculous this kind of ban is, commerical organizations, by linking up with Swiss color television stations, were able to essentially break the ban. This is an indicator of what will happen if governments try, for example, to prevent access to satellite systems.

Other trade-offs we see are personal computers being bought instead of appliances, electronic games being bought instead of the traditional toys and, of course, cassettes for video recorders and audio systems being bought instead of books. We can expect these intersector trade-offs to be amplified by coming computer communications developments affecting the home.

If we look at the communications area, we can expect satellites, from a social perspective, to make nonsense of national boundaries. In the long run, this could well affect the actual language we use. In however many years it may take, we will eventually see at least one international exchange language, which probably will be English. We also see, because of broadcasting and international communications, the growth of truly international markets. Just in the last 20 years we have seen how European, Japanese, and U.S. markets for products have become very similar.

We ought not to forget the power of advertising through this medium. When Japanese consumers can see what the price of grapefruits are in California they know that they should not be paying much more for grapefruit in Japan. Similarly, someone buying an automobile in the U.K. will know that he should be able to have it much more cheaply because of the advertising he sees from the Continent. In other words, market prices internationally will then be forced to become consistent by popular pressure.

We have already talked about the cable connection which will allow communications into and out of homes. Already we have security systems connected to computers from companies such as Honeywell. We can expect to see power utility companies also start to move into some of these areas because of their existing connections to all homes and businesses.

We should reiterate, however, that we are a long way from having individually selected video to houses or homes. Cable channels connected to computers are limited to the extent of the video they can show. Much more likely will be the application of optical storage chips or systems to provide catalogues and then the ordering through a network which would provide pricing and price changes, for example, on specific products. It is the combination of technologies in this commnunications area which is most important.

We have not talked about another vital area and that is of education and training. Already we see communications links between corporations and universities. Hewlett-Packard, for example in Palo Alto, has a video link to the university and lecture theatres at Stanford University for continuing education programs for its workers. We can expect to see more education in the home and a reversal moving back the education process to the home from schools. As we have seen in the U.S., the schools have failed in the last 20 years to improve the educational output. Skills have slid back from what they were 20 years ago. This is despite monumental investments by the Federal government. In this education and training area, particularly for industry, we can expect to see a combination of video technology with computer communications capabilities. This will become increasingly important as we expect to see more rapid change in our society and industry. In banking, for example, there are dramatic changes going on in the U.S. today in the kinds of products that are being provided to the consumer. Most of the banking staff themselves do not properly understand what these financial products are.

I think we will see education and training move from being an interrupted, aperiodic process to being a continuing process. Perhaps we could view the working week being reduced from 40 hours to 35 or 32 hours in the next 20 to 30 years and the remaining time being applied to a continuing education and training process. This education and training process might be compulsory or at least paid in the same way as wages.

Government is where some of the greatest potential changes are. Today demographic representative governments are breaking down. There are fewer "democracies" in the world today than there were 10 years ago or 20 years ago. There is increasing pressure on the democratic representative style of government. Such government is less responsive to changes in the environment than it should be, but it also is totally unresponsive to long terms needs of people. Since the unborn do not have a vote, they have no representatiion. I believe the only people that can represent the unborn, or the newly born, are the parents or prospective parents who have to consider how their children and grandchildren will grow up. The problem with elected representatives is that they only are really concerned with how they get reelected.

The growth of computer communications capability enables true democracy to be possible. We have seen recently in California and other states as well, the people taking it upon themselves to pass various government measures. In California, there have been a number of initiatives which have passed which have been absolutely opposed by most politicians. Now, through computer communications capabilities, we can have polling on topics. Essentially, the people themselves can vote on any issue. They can also elect officers or representatives for a longer term to act as a balance; as a guidance system, if you will, to try to smooth the flows of popular sentiment.

There is no doubt that at the moment the judiciary and the representative system in the U.S. do not represent the wishes of the majority.

Major activities within the government that could be affected by computer communications developments are the administrative functions. Many of the administrative functions of government are largely replaceable. Unfortunately, however, in the U.S., the computer communications systems installed in government are archaic and in danger of breaking down. As a result we are increasingly seeing contracts placed with private companies to develop and operate such systems.

One area of government outside defense which is necessary is the inspection and control processes which rely on field investigation, such as housing, health, environmental and criminal inspections and investigations. The paper pushers behind this field investigation activity and control activity could certainly be almost completly automated.

Of course, the issue raised here, particularly when we talk about government becoming more efficient, is that of the building of automated data bases and the interface of these data bases. The point has been made very well in the French research activity that centralizing data bases on individuals and identifying individuals and corporations, specifically in those data bases does not necessarily have to infringe on freedoms. The problem, at least in the U.S., is that people use the system to hide their minor or in some case major infringements of the law. For example, because in the various states driving infractions are not coordinated through data bases, we have situations where truck drivers involved in accidents may have as many as 20, 30, 40, or 50 prior infractions on their record in various states.

When we talk about international problems, I think we face some really severe issues. First of all the gaps are going to widen significantly. The first wave nations, those nations that are still in the agricultural stage are probably not going to be able to make it through the second or industrial revolution stage to the third. In some cases they may try and go almost directly from the first to the third without building up the second wave heavy industries. This could be a very effective approach but requires a massive investment in education and training, much more so than if you were moving into the heavy industry phase first.

I think we are also going to see gaps widening between the rich and the poor. As we mentioned earlier, computer communications developments will reduce the number of levels in a given organization but make the coverage of individual levels wider and the relative difference in compensation at the top and bottom much greater. We will see very particularly a gap emerging between the educated and the ignorant. Those that qualify for jobs and those that do not. We may find, as we have in England and certainly appear to be moving towards in the U.S., our class groups, which are rigid. There will be very little movement from one class to another. I think this will be fostered by the educational system.

New communications media, of course, are making these gaps apparent. International transmission of advertising and programs to literally hundreds of millions of people worldwide through television shows the quality of life that can be expected in certain levels of society in the U.S. and other countries. One of two things then occurs. Either people dream of achieving the same levels and strive for them, or if they see that such levels are unattainable, they react violently against that lifestyle.

A mechanistic society can be rigid and inflexible. Its resistance to change is represented by large organizations, governments, businesses and unions. We should not think that large businesses welcome change. In fact, in general, they do not. Small businesses are much more likely to welcome and profit from change because it provides opportunties. Generally, large corporations profit by regulation and protection from government, much more than the small.

As we move from a mechanistic society to an electronic society, I think we shall find an adaptive society. Hopefully, an adpative society will be much better. I believe there are two paths we can choose. We can choose nationalistic, industrial confrontation which can lead to conflict, some of which may be violent, or we can start to develop a cooperative approach which will address technological reduntancy, address the issues of privacy and the environment and also very importantly, address the cross-technology impacts, particularly between bioengineering and computer communications developments.

In closing I would just like to point out that dinasours became extinct. They may not have wished to become extinct, and in fact any observer would probably have thought they were so powerful they could not become extinct, but they did. Over the next 20 to 30 years we shall see some other dinasours in our social and industrial life become extinct and we must have the ability to address the new opportunities which their extinction will provide.

I believe that there will be the technology and the capability in this world to feed and clothe everybody and, ultimately, give everybody a worthwhile activity to perform, which may not be work.

Thank you very much for your attention.

Mr. WALGREN. Let me just ask at this point, are you able to make any kind of a percentage guess as to the potential for displacement? I know that everybody always argues that we are creating things on the other hand and all that sort of thing. But we run 8 percent unemployment or thereabouts. The office/factory covers a certain percentage of the American work force, and I don't know what it is, but some approximation. Do you see these replacement functions coming on at such a rate? What percentage of displacement, I guess, are we really looking at?

Mr. CUNNINGHAM. I think there is a difference between the potential and what is going to be realized. The biggest problem or fact that has to be considered is that people don't change as fast as some vendors and other people would like. People just don't change as quickly as systems do. So, if you look at the potential for displacement, I would say, it is a minimum of 20 percent. Studies from Austria, Japan, and Holland have said it would be as high as 50 percent in certain areas. I think you have had Leontief here talking about his Austrian study. I thought that had some very interesting insights.

By the way, this is not our area of expertise. We are involved in projecting what the systems will be, as opposed to what the actual impacts on employment will be. But my guess is a minimum of 20 percent potential displacement. What will be realized, I don't know. It depends on how fast people change. Essentially, it depends on economic growth. If we have a growing economy with new things being created and new opportunities and new activities, the situation will be different. If nothing happens, we will see that percentage go up and up and up. It will be a self-feeding mechanism.

Technology will drive the cost of processing, storage, and communications down. It is doing so very, very rapidly—there are more and more crossover points where it is more effective to install a system than it is to use people. The jobs that will be affected will be moving up-scale rather than down.

I have heard the chairman of Mitsui Engineering, which produces ships, give an example in Japan about how they automated ships, replacing professional functions to the extent that the next generation of ships will have no professional people on board. They will still have people to go around and scrape the paint and do the menial tasks because humans are less expensive than robots. The job functions that were attacked were upper level.

You can talk about what the implications are, but that, basically, is what we see happening. So, growth is the solution.

Mr. **Walgren**. Yes.

Let's turn with that to Mr. Williams, and then we will come back and talk a little bit with the panel as a whole.

Welcome to the committee, Mr. Williams. We are glad you could join us. Mr. Williams comes from the United Steelworkers of America, which represents both office workers and manufacturing workers. We are most interested in your perspectives on this.

We have been talking for about 10 minutes in our presentation. There is even a light system that will signal a red light in 10 minutes or so. But my point is not that that is the outside limit, but in getting us through the witnesses that we have, we want to shoot for that timeframe. Then we can develop some points in the informal discussion.

Welcome to the committee, and please proceed to make your points as you would feel best.

[The biographical sketch of Mr. Williams follows:]

USWA

News from the
Steelworkers

UNITED STEELWORKERS OF AMERICA, AFL-CIO-CLC
Five Gateway Center, Pittsburgh, Pa. 15222 · Phone 412-562-2666
Russ Gibbons, Director of Public Relations

Biographical Sketch of
LYNN WILLIAMS
International Secretary
United Steelworkers of America
AFL-CIO · CLC

Lynn Williams, International Secretary of the USWA, is the first Canadian to hold one of the top International offices. He was elected by a referendum vote by members in the United States and Canada in 1977.

He brings to the office of Secretary a background of extensive experience in collective bargaining with wide experience in negotiating with the multinationals in the metal mining and manufacturing industries. His initiatives in labor education and foreign affairs have brought the union wide acclaim in the labor movements of Canada and the United States.

Convinced, as he related, "that trade unionism is a much more effective way to work at social needs and objectives than any other," he accepted an organizing job with the Canadian Congress of Labour, later the Canadian Labour Congress (CLC), to work on campaigns throughout Ontario and Saskatchewan. In 1956, he joined the Steelworkers staff and was assigned to the Niagara Peninsula, where he soon was named area supervisor. Under his leadership the USWA doubled its membership in the area.

In 1965 he was transferred to District 6 headquarters where he became heavily engaged in bargaining, labor education and political action. He led major negotiations in the nickel and other nonferrous industries.

Long active in labor's foreign affairs, representing both the Canadian Steelworkers and the Canadian Labour Congress, he brought to the International headquarters strongly established relations with free world trade unions.

He stresses the benefits of close communications between working people of different nations and their labor movements. Mr. Williams represents the United Steelworkers in conferences of the International Metalworkers Federation (IMF) and serves on its Executive Committee. He is involved in many IMF functions such as the North American-Japanese Metalworkers Conference.

Upon the retirement of District 6 Director Larry Sefton, Mr. Williams was nominated and overwhelmingly elected director of the 130,000-member district, assuming office in June of 1974. He moved aggressively to expand the district's safety and health programs and stepped up the tempo of district organizing activities.

Born in 1924 in Springfield, Ontario, he attended public schools in several industrial towns of the province where his family moved. He earned a degree at Hamilton's McMaster University in 1944 while working part time as a community organizer. He next served in the Canadian Navy and afterwards returned to Toronto for post-graduate work in economics at the University of Toronto.

A member of the USWA almost his entire adult life, he joined the union in 1947 when he took a job in Toronto at the John Inglis plant. He is still a member of the local at that plant, Local 2900.

At the International headquarters he is responsible for the following departments: International Affairs, Education, Public Relations, New Members, Personnel & Local Union, By-Laws & Elections and Data Processing.

Mr. Williams and his wife, Audrey, are parents of four children. They reside in Pittsburgh with their younger son.

Mr. WILLIAMS. Thank you.

I am sorry to have been late this morning. I am working from a script, so I will try to go quickly.

I am pleased to be here to outline some of the thoughts of our union and, I think, the labor movement generally on a most important and pressing subject—automation and technological change.

Graduating students at Anne Arundel Community College in Arnold, Md., not far from here, were upset recently when it was announced that the main commencement address would be given by Robot Redford—not Robert, but Robot—who would give a speech written by its owner, in conjunction with the college faculty. While the point was to emphasize the brave new high technology world they would be entering, student leaders decried the choice, saying, "We deserve better than that."

I can understand that kind of a reaction. With some 150,000 steelworkers now on layoff, who may never return to the jobs they had held, we in the United Steelworkers, too, find ourselves feeling very strongly that those brother and sister members deserve better. We have grave concerns about the new world that our society and those across the globe find themselves entering, and it is some of those concerns that I want to share with you today.

Let me say first, on the other hand, that American unionists today are not Luddites—bands of English workers said to have been led by Ned Ludd in the early 1800's, who destroyed knitting frames and other manufacturing machinery in the belief that their use diminished employment.

Yes, we know that changing technology in basic steel has cost jobs and, in recent contracts, have negotiated some language—far from adequate—offering a very limited measure of protection in clear cases of such occurrences. From the peak production and maintenance work force in basic steel of over 571,000 in 1953, we have seen employment massively, if gradually, decline to 307,400 in 1980 and, then even more precipitously, to 208,400 in 1982, as the industry felt the devastating effects of deep and prolonged recession, as well as those of the structural changes underway. We are well aware of new projections by a group of academics, Congressmen, and labor and business leaders that the labor force of the Nation's smokestack industries may shrink still further, from the present 20 percent to but 8 percent of the labor force by the 1990's.

Part of the decline is due, in steel, to modernization, the move from open hearth to basic oxygen and electric furnaces, and to the continuing casting process. Yet, we recognize that the failure to modernize can cause even greater employment problems because of pressures on the international scene. While import penetration averaged 2.3 percent of apparent supply during the decade of the 1950's, imports by 1965 has exceeded 10 million tons for the first time, jumping that year alone by nearly 4 million tons. During the 1970's, imports as a percentage of apparent steel supply ranged from 12.4 to 18.1 percent in 1978, and last year reached the highest point on record, 21.8 percent.

As Congress Office of Technology Assessment's 1980 report on "Technology and Steel Industry Competitiveness" points out, the domestic "industry has been slow in adopting certain productive new steelmaking technologies." It is behind other steel-producing nations in the diffusion of continuous casting, for example—in some cases by huge margins. It trailed in the conversion to BOF's and in the use of electric furnaces for other than specialty steels.

Our union believes that, given the status of world competition, modernization is a necessary path for job security and stability. It is under this premise that the USWA supported the steel stretch out legislation, granting extension of pollution compliance deadlines, but requiring those savings to go into modernization. The trigger price mechanism of a few years ago was conditioned upon a modernization commitment. And as most of you must know, unlike United States Steel's David Roderick, who seems to have other ideas, the March 1 contract settlement between our union and seven major steel producers, which granted them $3 to $3.5 billion in temporary wage and benefit reductions, conditioned the agreement on that money being used to enhance the competitiveness of existing plants.

Beyond the betrayal that we feel about United States Steel's current proposal to import British steel slabs for finishing in this country, we believe it endangers raw steelmaking per se in this Nation. Convinced that an industrial society cannot continue to exist as such without an industrial base, we will fight this proposal with all our strength and ask your help. This Congress should understand, I think, that if we become nothing more than a finishing nation, we may well be finished as the strongest industrial Nation in the world community.

Having now indicated that the history of the United Steelworkers of America is not one of opposition to technological change, which indeeds holds out some prospective in some industries of relieving workers from tedious or hazardous work, let me quickly add that we have tremendous concerns about the shape and pace of that change, and about who may win and who may lose by it.

A recent study at Carnegie-Mellon University in Pittsburgh—no longer the undisputed hub of the Nation's steel industry—asserts that the current generation of robots has the technical capacity to carry out jobs which represent one-third of all present manufacturing employment, while it will become theoretically possible in the 1990's for robots to assume all the manufacturing operations in the automotive, electrical equipment, machinery, and fabricated metal industries.

The effects of change as rapid as that cannot be reasonably mitigated through attrition. Its effects are being and will be felt by those who know no other work and are not ready for retirement. This most revolutionary and powerful technological development which the world has ever seen impacts on the working people of our society—the special concern and responsibility of the labor movement—more seriously, more dramatically, more destructively than on anyone else.

From the perspective of history, we can recognize that the first industrial revolution ultimately did provide the basis for unprecedented prosperity for the citizens of industrial countries, but we should never forget the desperate Dickensian sufferings of working people in the process—millions of whom were born, lived, and died with nothing but abject misery and poverty as their share of this miracle of industrial progress.

The consequences of job displacement touch the individual and his or her family, but also the society as a whole. The meaning in life that work provides is seen in the question that most frequently follows introductions—"What do you do?" It is not surprising that an increased number of divorces, suicides, and other individual and family dysfunctions occur at times like these, when high unemployment is prolonged. But the cost to society also is high. For each 1 percent of unemployment, it has been estimated the cost in public benefits and uncollected taxes is between $25 and $30 billion. To those truly concerned with getting a handle on burgeoning Federal deficits, this fact about joblessness bears repeating again and again and again.

In Japan, where a majority of the world's total current supply of robots is in use, there is beginning to be concern about excessive unemployment, which stands at a little above 2 percent. There, a private research group, the Science and Economy Society, a year ago predicted that, until 1985, jobs lost to robots in the steel, chemical, and nonferrous metals industries should be more than made up for by the increased demand for workers in the areas of electronics, precision machinery, communications, and space. The organization, however, saw the effects of technological change becoming "a major social problem in that country," probably in the 1990's, and declared, "We must face up to the consequences."

The question here, as there, is one of how to make more humane the undoubtedly inevitable march toward shattering changes in the nature and extent of human work. It is my view and that of the United Steelworkers of America that the quintessence of a real and viable solution to the problem in the United States is an extension of workers' rights protected by the Federal Government.

Japan's "lifetime employment commitment" requires the employer to develop constructive alternative ways in which the skills and abilities of workers no longer needed in their traditional jobs may be harnessed. While not attempting to advocate the "Japanese system," it is clear that a solution in the United States, too, must deal with the problems of current workers. We court societal chaos if we do not act soon to begin to cope with already large and growing job displacement.

What is needed is policy that strikes a balance between the need for progress and the need to protect the economic security of workers and, moreover, enables them to participate in the control of their own destinies.

An initial principle should be that radical technological change should never be introduced into a workplace without advance notice, nor without meaningful advance consultation. We should be beyond the circumstances in which cataclysmic change can be imposed upon people without their having a full opportunity to be knowledgeable about it, to deal with it, to bargain about it, and to be fully involved in the decisions relating to it.

We can and we must be far less timid in the area of training and retraining. Whether viewing the situation from the perspective of cold-hearted economic logic or from that of warm-hearted concern to the needs of people and the obligation to provide the framework for a just and decent society, it seems clear that we must make a more massive effort in this regard. And it is a task that must involve virtually every segment of society—from government, business and industry, the trade union movement to our educators, churches, and community organizations.

Trade negotiator Brock has predicted that workers in the future can be expected to change jobs on the average of four times during their working lives. The time has come to very seriously look at such questions as pension portability that was discussed to some degree during the debate on ERISA in 1974.

But a more fundamental issue must begin to be addressed, one that is tentatively approached by current proposals for legislation that would allow work-sharing and the sharing, too, of unemployment compensation. It is the need—if machines are taking on much of the work of producing goods and services for the society—to devise methods of fairly dividing up the remaining work and the increased possibilities for leisure, which provides growing opportunity to enrich our own and our fellow citizens' lives in cultural, intellectual, social, and recreational pursuits.

The labor movement always has believed that a reasonable social contract should include a full employment commitment. But that doesn't mean 40 hours a week and retirement at 65 when circumstances cry out for a lowering of those figures.

Many nations of the world are already far ahead of us dealing with the social effects of economic dislocation. This was made crystal clear in a labor study tour of Sweden, West Germany, and the United Kingdom a few years ago in which members of our union participated. While there were variations, all required advance notice of dismissal of workers and negotiations in such cases with the union or plant work council involved. Labor market boards at various levels, including the national, have a broad array of programs for preventing dislocation or cushioning its impact. And when job loss does occur, unemployment insurance systems tend to be used far more flexibly and creatively than in this country.

Let me conclude on two notes. It would seem that those countries which have best handled the world's present economic crises are those which have a conscious industrial policy arrived at by some process of social discussion and consensus which enable the productive abilities of the economy to be coordinated and expended most efficiently and successfully. The technological revolution, in concert with runaway capital in search of exploitable labor and resources, only magnifies the need for such a policy in the United States.

Looking further ahead, there are many critical issues impacting on that technological revolution whose serious study can be ignored no longer. The Congressional Clearing House on the Future, under the leadership of Robert Edgar of Pennsylvania, may well be doing this body's most crucial work. Such issues include world population, balancing the need for expanding economies versus those to conserve natural resources and preserve the environment, and the possibility of accidental war in a heavily armed world in which high technology is in danger of outpacing human control.

This latter prospect, I believe, is one of the very great threats of the current exponentially expanding technology. Without great care, we may see it distort human value systems and be lost from democratic control. Wasn't that indeed one of the messages of George Orwell's great novel "1984"? That year fast approaches, and Orwell's prophetic vision can be ignored only at enormous peril.

As I have tried to indicate throughout these remarks, democratization is key to our ability to cope with this technological revolution. Rather than allow it to dominate, we must find ways of putting it to work to expand the quality and creativity of life—all life—on Earth.

Thank you.

[The prepared statement of Mr. Williams follows:]

TESTIMONY
OF
LYNN WILLIAMS, INTERNATIONAL SECRETARY
UNITED STEELWORKERS OF AMERICA

My name is Lynn Williams. As the international secretary of the United Steelworkers of America, I am pleased to be here to outline some of the thoughts of our union and, I think, the labor movement generally on a most important and pressing subject -- automation and technological change.

Graduating students at Anne Arundel Community College in Arnold, Md., not far from here, were upset recently when it was announced that the main commencement address would be given by Robot Redford...not Robert, but Robot, who would give a speech written by its owner, in conjunction with the college faculty. While the point was to emphasize the brave new, high-tech world they'd be entering, student leaders decried the choice, saying, "we deserve better than that."

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Japan's "lifetime employment commitment" requires the employer to develop constructive alternative ways in which the skills and abilities of workers no longer needed in their traditional jobs may be harnessed. While not attempting to advocate the "Japanese system," it is clear that a solution in the U.S., too, must deal with the problems of current workers. We court societal chaos if we do not act soon to begin to cope with already large and growing job displacement.

What is needed is policy that strikes a balance between the need for progress and the need to protect the economic security of workers and, moreover, enables them to participate in the control of their own destinies.

An initial principle should be that radical technological change should never be introduced into a workplace without advance notice, nor without meaningful advance consultation. We should be beyond the circumstances in which cataclysmic change can be imposed upon people without their having a full opportunity to be knowledgeable about it, to deal with it, to bargain about it, to be fully involved in the decisions relating to it.

We can and we must be far less timid in the area of training and retraining. Whether viewing the situation from the perspective of cold-hearted economic logic or from that of warm-hearted concern for the needs of people and the obligation to provide the framework for a just and decent society, it seems clear that we must make a more massive effort in this regard. And it is a task that must involve virtually every segment of society -- from government, business and industry, the trade union movement to our educators, churches, and community organizations.

Trade negotiator Brock has predicted that workers in the future can be expected to change jobs on the average of four times during their working lives. The time has come to very seriously look at such questions as pension portability that was discussed to some degree during the debate on ERISA in 1974.

But a more fundamental issue must begin to be addressed -- one that is tentatively approached by current proposals for legislation that would allow work-sharing and the sharing, too, of unemployment compensation. It is the need -- if machines are taking on much of the work of producing goods and services for the society -- to devise methods of fairly dividing up the remaining work and the increased possibilities for leisure, which provides growing opportunity to enrich our own and our fellow citizens' lives in cultural, intellectural, social and recreational pursuits.

The labor movement always has believed that a reasonable social contract should include a full employment commitment. But that doesn't mean 40 hours a week and retirement at 65 when circumstances cry out for a lowering of those figures.

Many nations of the world are already far ahead of us dealing with the social effects of economic dislocation. This was made crystal clear in a labor study tour of Sweden, West Germany, and the United Kingdom a few years ago in which members of our union participated. While there were variations, all required advance notice of dismissing workers and negotiations, in such cases, with the union or plant's work council involved. Labor market boards at various levels, including the national, have a broad array of programs for preventing dislocation or cushioning its impact. And when job loss does occurs, unemployment insurance systems tend to be used far more flexibly and creatively than in this country.

Let me conclude on two notes. It would seem that those countries which have best handled the world's present economic crises are those which have a conscious industrial policy, arrived at by some process of social discussion and concensus, which enable the productive abilities of the economy to be coordinated and expended most efficiently and successfully. The technological revolution, in concert with runaway capital in search of exploitable labor and resources, only magnifies the need for such a policy in the United States.

Looking further ahead, there are many critical issues impacting on that technological revolution whose serious study can be ignored no longer. The Congressional Clearing House on the Future, under the leadership of Robert Edgar of Pennsylvania, may well be doing this body's most crucial work. Such issues include world population, balancing the need for expanding economies vs. those to conserve natural resources and preserve the environment, and the possibility of accidental war in a heavily-armed world in which high technology is in danger of outpacing human control.

This latter prospect, I believe, is one of the very great threats of the current exponentially expanding technology. Without great care, we may see it distort human value systems and be loosed from democratic control. Wasn't that, indeed, one of the messages of George Orwell's great novel "1984?" That year fast approaches, and Orwell's prophetic vision can be ignored only at enormous peril.

As I have tried to indicate throughout these remarks, democratization is key to our ability to cope with this technological revolution. Rather than allow it to dominant, we must find ways of putting it to work to expand the quality and creativity of life...all life...on earth.

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Mr. **Walgren**. Thank you very much, Mr. Williams.

Part of our problem is that the future is coming so rapidly in this area, I think, that it is tough for political people to pay the kind of attention to the future as they do to the present. That is one of the reasons some of these issues don't have the priority that others might have in the work product of the Congress. Yet, if sensitivity to them is not developed at the proper time, it might be lacking, and the Congress will be really out of step with producing what is in the best interests of the country.

Mr. Williams, you touched on a couple of contract points that the steelworkers were interested in, particularly the importance of the discussion of layoffs in advance. And Ms. Lampkin indicated that AFSCME also had a set of contract interests.

Can I ask first, Ms. Lampkin, and then Mr. Williams, to sort of expand on the kinds of things that your organizations are asking to include in present contracts that are related to this area?

Ms. **Lampkin**. We have a book called "Facing the Future, AFSCME's Approach Toward Technology," which basically goes through the list of contract protections and gives sample language.

We represent so many different kinds of workers—not just office workers, obviously, but a lot of blue-collar workers, a lot of sanitation, waste-water-treatment workers—and all of these occupations are being impacted very heavily by automation and technology. Trying to write something general enough, yet specific enough, to be helpful has been a major problem here.

We feel that there are areas of the contracts that we now have that we can strengthen—the prenotification trial period, advance notice, the kinds of things we are interested in, are detailed in chapter 4 of this book. I can discuss them a little if you would like.

Mr. **Walgren**. Perhaps we will look at that and make a portion of that that deals specifically with some of the contract goals.

[The material follows:]

Submitted by Linda Lampkin
American Federation of State, County
and Municipal Employees

FACING
THE FUTURE

AFSCME'S APPROACH
TO TECHNOLOGY

AFSCME®
in the public service

CHAPTER 1 - BACKGROUND FOR CHANGE

We are in the midst of what many people are calling "the second industrial revolution." New computer technology will alter the way work is performed in the office, in the plant and in the home in very basic ways, comparable to the development of machines to replace horsepower and human muscle-power in the 19th century. These changes will not occur overnight, but even now, in the relative infancy of the computer age, they are occurring very rapidly. New technology holds promises and threats for those currently working and for young people preparing to enter the work force. The issues are complex, and tradeoffs are many.

What is New Technology?

Most of the technologies of the 1980s are based on the microprocessor, a tiny silicon chip which has been imprinted with layer upon layer of the electronic circuitry required for a very sophisticated computer. First developed in the late 1960s, the chip has made the current explosion of cheap and powerful microcomputers possible. In the 1980s, an inexpensive handheld calculator can perform almost all of the functions of the original room-sized vacuum tube computers of forty years ago. Changes are occurring so rapidly that, by the turn of the century, a similar comparison will be made with the "antique" computer systems of today.

The combination of low cost with high sophistication is the key to the microprocessor's position as a revolutionary technology. It is now both technically possible, and economically feasible, to use computer power on a wide variety of jobs for the first time. Some of these uses may make economic sense for the employer, but they can pose problems for the workers affected.

Computers are not the only new technology which workers will be facing in the 1980s. In sanitation, for example, there is a growing variety of trucks and lifts and disposal bins that many cities and counties are purchasing. In health care, new drugs and laboratory procedures may pose health problems for nurses and technicians. Laundry staffs at institutions may have their jobs threatened by automated laundry facilities. In state and local highway departments, equipment for road repair and street cleaning is always being modified in the name of improving efficiency.

What, then, is new technology? As far as workers are concerned, new technology is any change in equipment or methods of work that may have a significant impact on wages, working conditions, job security, and/or the size of the bargaining unit.

Why is Technology Introduced?

The answer management always gives is to improve productivity -- lowering the cost of producing a given quantity of goods or services. This simple answer disguises two basic problems, however. First, it is extremely difficult, maybe impossible, to measure productivity in many service jobs. Second, there are many ways to improve productivity, and each can have a different impact on jobs and the quality of services. The union must shift the debate beyond being "for" or "against" productivity and to the underlying issues of management's goals, and how a particular technology may help achieve them at workers' expense.

To deal effectively with new technology, the union must understand that the impact of the equipment on the health, safety and working conditions of employees may not always be due to the machinery itself. The union needs to evaluate how the equipment fits into over-all management strategy -- which may involve reorganization, reclassification, contracting out, budget-cutting, as well as new technology. If the union understands how technology fits management's goals, the union can better judge how new technology will affect its membership, whether allies can be made with the public or service recipients, and how to overcome management resistance to the union's own goals.

Management introduces technology for one or more of the reasons outlined below. Each can have a different impact on jobs and quality of services because each represents different management goals for the introduction of new technology.

1) Fashion.

New technology is fashionable. Just because a decision to buy new equipment has been made, it may not be fully justified, even from management's own point of view. Decisions are often based on an inadequate analysis of the problem, and incomplete information about alternative solutions or the kinds of new machinery available for use. Management often fails to consult its own work force about positive changes that can be made in the way work is done, and jumps blindly on the technology bandwagon.

2) Expanding Services At No Increase in Costs.

New technology can increase the quantity or quality of services without increasing costs. From the public's point of view, this is perhaps the ideal goal of new technology since it offers the best of two worlds -- better services, at no added cost. From the worker's point of view, this can also be very positive, if it allows the current work force to deal more effectively with growing workloads, bottle-necks, and stress. If the new technology leads to reduced labor, however, the employee and the community will bear increased costs if the current work force is disrupted by layoffs or downgrading. As an alternative to layoffs and downgrading, additional benefits can be gained by applying savings from new technology to the development of new or expanded services of importance to the community.

3) Expanding Services and Increasing Costs.

Sometimes new technology is adopted because it improves the quality and quantity of services, or enables whole new services to be provided, even though costs may increase. Higher costs are accepted because the expanded services are considered worth the price. This is the case, for example, with very expensive new medical technology which allows doctors to diagnose and treat patients more quickly and effectively than before. Technology introduced to provide new services may also provide new jobs and opportunities for training and upgrading of current workers. On the negative side, increasing costs in one area may create pressures to cut costs in other areas of the budget. New technology for treating and disposing of waste may help create a cleaner environment, for example, but it also appears to increase pressures for reducing costs in other parts of the sanitation budget, such as refuse collection.

4) Cutting Costs.

New technology is often embraced as part of a solution to the need for budget cuts, without regard for its potential for improving services. The goal is to cut costs as much as possible while cutting services as little as possible. Management may attempt to cut back service because of the expected benefits of technology. These benefits may or may not be real, however; the technology is valuable to management primarily because it cuts costs, not because it improves services. AFSCME employees have the most to lose in those cases in which new technology is used as part of an over-all strategy of cost-cutting.

5) Making Employees Work Harder.

Sometimes new technology cuts costs by making employees bear some of the true costs of providing the goods and services. New machinery may speed up the pace of work, or enable management to monitor work and measure output more closely. As a result, employees work harder under the new system than under the old. They bear the costs of additional stress and fatigue and possibly physical risk but do not receive compensation for the increased intensity of their work. One example of this cost-shifting can be found in some applications of visual display terminals (VDTs). Data entry work can be reorganized so that the pace and duration of the operator's time on the machine are increased, and the VDT can be used to closely monitor what work is done. This may lead to increased stress, fatigue, headaches, muscle aches, and eye strain. Ideally, new technology should improve productivity by making the employees involved work more effectively, not harder.

The Best and The Worst of It.

The effect on workers when new technology is introduced is difficult to generalize, because the technologies are so numerous and changing, and their applications even more diverse. At its best, however, new technology can provide:

higher wages and benefits based on improved productivity and the greater skill of the work;

opportunities to obtain new skills;

better working conditions with a cleaner and more comfortable environment, less stressful work;

improved safety and health on the job;

work that requires less effort for the same or better results;

perhaps a shorter work week or work day with no loss in pay;

At its worst, none of these things may happen. Rather, the following picture can emerge when new technology is introduced:

jobs that are more routine than before, as workers are regulated by the pace and routines of the machine, rather than vice versa;

"deskilled," jobs and lower wages, reflecting the fact that the machine has taken over the skills of workers;

more stressful and more uncomfortable jobs, resulting from bad machine design or the increased pace of work and closer supervision;

increased safety and health risks due to poor equipment design;

reduced opportunities for training and career advancement;

loss of jobs;

reorganization that eliminates some of the bargaining unit.

It is clear that the implementation of new technology can be extremely critical to the strength, perhaps even survival, of the union and its members' jobs.

CHAPTER 2 - IMPACT IN THE PUBLIC AND NONPROFIT SECTOR

It is not possible to anticipate all of the areas in which new technology will affect AFSCME members. Even those new technologies that are familiar can pose different problems and have different potential benefits, depending on how they are used in a particular situation. The basic outlines of the new technologies that will affect large numbers of public and nonprofit employees can be described, however. What follows are some examples of special targets for technological change in the 1980s.

Visual Display Terminals/Office Automation

The visual display terminal (VDT) is at the heart of the revolution in office automation. By the end of the decade, potentially every clerical, technical, and professional job will use VDTs. A number of blue-collar jobs will be restructured to use VDTs -- some heating plant and waste treatment plant operators, for example, now monitor the condition of their equipment through VDTs.

The Machinery

Like a television, the display of a VDT is produced by a cathode ray tube, although in the future different kinds of displays, such as the liquid crystal display found in many digital watches and calculators, may be available. However, the heart of the VDT is an unseen microprocessor --computer on a chip-- that exists inside the machine or, sometimes, in a larger computer located elsewhere but connected to a terminal. The microprocessor is the brain which determines what the machine can do, whether it is word processing equipment, a library's information base, or a hospital ward monitor.

VDT equipment can present safety and health hazards to workers if the machinery is not designed properly or is not used in an appropriate work setting. A poorly designed or poorly maintained VDT may have a display that flickers, is dull, or offers a combination of character color and screen background color that causes fatigue and eye strain. A badly designed work environment may result in glare on the screen. Chronic headaches and eye strain are common complaints among frequent VDT users. Backaches, neck aches, and even a form of tendonitis in the wrist can be the result of equipment that is poorly placed in one's work area and is not adaptable to differences in users' heights or preferences for viewing distance. Lack of appropriate auxiliary equipment, such as comfortable chairs and wrist rests, can also increase physical ailments resulting from VDT operation.

Finally, low-level radiation emitted by the equipment may prove to be a long-term health risk. Research to date suggests that radiation from VDTs -- even poorly maintained ones -- is not at hazardous levels. There is an ongoing debate that extends beyond just VDT research, however, over how much or how little is known about the effects of long-term exposure to very low levels of radiation. There have been reports from several work places that the incidence of cataracts has increased with the use of VDTs. From other offices, there have been reports of an increased rate of miscarriages. Researchers are beginning to evaluate these claims and whether some aspect of VDT equipment may be responsible.

Fortunately, a wide variety of different equipment designs and features for VDTs is now on the market. Thanks to feedback from users and pressure from unions here and abroad, VDT manufacturers have incorporated a number of useful features into their more recent models. These include tiltable display screens, contrast controls, and detachable keyboards (connected by a coiled cord to the display screen) which make the equipment more adaptable to the individual worker and particular work space. Specially-designed document holders are available with some equipment to make it easier for data entry operators to work simultaneously with a paper document and the electronic display. Glare screens are available in those situations in which office lighting has not been redesigned. Some new offices may have "variable lighting" at work stations so that an appropriate amount of light is available for each kind of task -- on or off the VDT. Given the number of designs and options available, it is important that the union have input in the decision to obtain new office equipment, and that users have an opportunity to try out equipment in a trial period.

How VDTs Are Used

Experience with VDTs suggests that the main problems for workers from this new technology do not result from the machinery itself, but from the way the employer uses the machinery to redesign work. Computerized office equipment can make routine daily tasks much more bearable and easier for all white-collar workers. The computer at the heart of the VDT may also be used, however, to measure workload and work performance, using some quantifiable but overly simplistic measure such as "number of keystrokes" per hour. Even without actually counting keystrokes, the very efficiency of the computer may speed up work and pressure employees to work harder, without any additional compensation. The employer may not provide appropriate rest breaks for employees. Some researchers estimate that operators need a 15-minute rest break for every hour or two on the VDT, depending on the intensity of the work; others recommend that total time on a VDT be limited to 50 percent of the work day, with other tasks assigned for the remainder of the time.

The ability of a computer to handle many complex tasks in a routine way may be used to place the intelligent aspects of the job inside the machine rather than inside the person. Jobs may center around following set routines that require little training. Over the long term, this automation of "mental labor," if it results in de-skilling of jobs rather than the development of new and equally valuable skills, can reduce training requirements for jobs, lead to reclassification to lower pay grades, and open the door to increased use of part-timers or home-workers.

The high cost of new office technology may put pressure on employers to keep employees on the machine for as much of the day as possible, and to institute shift work for office employees, especially data entry operators, so that the machines are used constantly. The combination of the VDT and modern communications networks may enable office work to be decentralized, shipped to other offices at the throw of a switch, perhaps even contracted out or beamed into the home.

What Unions Have Done

Unions in the United States and abroad have negotiated a variety of protections for workers who must operate VDTs. These include:

- Frequent rest breaks for VDT operators;
- Alternating VDT work with other work so as to minimize eye strain and fatigure and increase the variety of work;
- Prohibition against work measurement;
- Regular eye exams for VDT operators;
- Training programs; and
- Pay differentials and upgrading.

Refuse Collection

Sanitation departments throughout the country are facing pressures to cut costs with a variety of measures, including contracting out, increasing workload, and introducing new technology. Where contracting out is being considered, new technology may be an alternative that can save jobs and keep service under public control. New technology may reduce crew size, however, and investment in new equipment can increase expenses initially.

The Machinery

Even refuse collection is being affected by the computer, in the form of computer-aided design of collection routes to increase the efficient use of vehicles and crews. The kind of technology of most concern to sanitation workers, however, is not the computer, but mechanized improvements in truck and bin design. Older trucks are being "retrofitted" with mechanical lifts to pick up larger bins. New trucks and lifts are being designed for easy and swift pick-up of large, specially-designed "supercans" and operation by two- or even one-person crews. "One-person packers" may be designed to get through alleys and streets that are inaccessible to larger trucks; the smaller trucks will periodically dump their loads into much larger trucks which, when full, will make the long drive to a disposal site. New, larger bins are being designed to fit into these new collection systems. In some communities the familiar metal and green plastic garbage cans are being replaced with standardized 80-gallon (or larger) wheeled trash bins.

The mechanized lifters may be subject to a high breakdown rate. If this happens, and if back-up equipment is not available, the crew may find themselves heaving extra-large trash bins into their truck, increasing the risk of injury. One-person trucks increase job risk because there is no other crew member who can provide assistance if any kind of an accident or emergency situation should arise. Certain equipment may not be appropriate for some conditions; it can be difficult or impossible, for example, to roll large trash bins to the truck in very hilly areas or in snowy and icy weather. Where the new equipment is designed and maintained properly for local conditions, however, the job of refuse collection can be made easier and cleaner.

How The Equipment Is Used

Regardless of how well the equipment functions for those crews doing the work, the fact is that this machinery is "cost effective" for the employer because it enables more work to be done with smaller crews (or a smaller number of same-size crews). Jobs may also be lost because the frequency of refuse collection is often reduced when the new machines are introduced. The employer may argue that the larger bins, supposedly supplied with secure animal-proof lids, permit less-frequent collection without increasing risks to public health. This may not always be the case however, and the union may be able to use the threat of reduction in service to save jobs.

The introduction of new equipment can also mask management's attempts to modify or abolish the task incentive system, a hard-won provision in many sanitation contracts that sets up standard routes which constitute a fair day's work regardless of the actual time taken for completion. The new technology changes the "rules of the game" so that management may take the opportunity during the next round of negotiations to try to weaken the task system.

What Unions Have Done

Sanitation locals have won a number of job security and other protections, including:

- crew size agreements;
- no layoff protections and transfer rights;
- wage premiums for operating more productive equipment with smaller crews;
- joint labor-management determination of an appropriate eight-hour task;
- trial periods for use of new equipment.

Locals have also influenced the implementation of new systems of refuse collection through effective public relations and lobbying. In some cases, management's cost and benefit analyses can be shown to be inaccurate. Management may have underestimated the costs of maintaining the equipment or may not have planned for needed back-up equipment and crews. Surveys of customers may show hostility to the idea of reducing the frequency of collections or of locating large, unsightly trash bins in neighborhoods, or of making citizens responsible for rolling their own cans to the curb -- a potential problem for the elderly and others. Customers may become allies in support of current service levels.

Other Jobs Affected

A number of other occupations in the public and nonprofit sector are also likely candidates for technological change in the 1980s. These include:

Health care professionals and technicians. Computers are being used to monitor critical care patients so that a single nurse can watch over as many patients as two or more nurses could monitor a few years ago. Computers are also used for management information systems in hospital finance, and billing for control of inventories of drugs and other supplies, and for employee, patient, and facility scheduling.

In the laboratory, microcomputers combined with new techniques for radiology and chemical analysis will greatly increase the productivity of medical staff. Machines are now available that can perform dozens of tests on a single small sample of blood dropped on a slide coated with multiple layers of chemicals and testing agents.

A procedure as basic to medical diagnosis as urinalysis may soon be completely automated. These computers will not only help to make a large number of analyses quickly, but they can also be programmed to select particular tests from a large repertoire of possibles tests. This ability to program a multipurpose machine to perform a customized set of tests will help make the equipment economically feasible for small as well as large hospital laboratories. A new generation of computer systems will combine diagnostic power with financial control; the same computer that performs a blood test will be responsible for filing the results and billing the patient or third party. The expense for this additional equipment can increase pressures for cost containment in other areas of medical care.

Institutional support staff. Support staffs in hospitals and other large institutions may soon find themselves working side by side with robots. A number of hospitals have already installed robot carts that follow electronic tracks in the floor to deliver food and supplies to various locations around the hospital. The carts have specially-designed modules that can accommodate refuse, hot and cold food, pharmaceuticals, linen, mail, and even flowers. In a single trip along a preprogrammed path down hallways and into elevators and rooms, a cart can pick up a thousand pounds of dirty laundry, dishes, or garbage, dump it at a destination, and return for more. Designers estimate that this automated delivery system can cut work hours spent carrying supplies and refuse by 80 to 90 percent. In a 900-bed hospital, this system could displace up to 100 full-time employees.

Librarians. Thousands of librarians are already working with VDTs. In addition to the potential problems associated with VDT use, new information technologies are transforming the nature and skills of professional librarian work. Librarians may find the new skills of manipulating large computerized data bases in heavy demand. On the other hand, some librarian jobs may become more routinized. The proportion of jobs in informations services that consist primarily of data entry and simple retrievals can be expected to grow. Some information systems may become so "user friendly" that professional librarians may be replaced by less well-trained staff at many branch and smaller libraries.

Court employees Faced with chronically high caseloads, antique bookkeeping and pressures to schedule staff and courtrooms as efficiently as possible, many court systems have turned to computerized information systems to solve their problems. Court personnel, like other office workers, must face the problems associated with VDT use. In addition, court employees may have to face the additional pressures of being part of a huge, sometimes overwhelming, system for tracking and scheduling cases, in which all the parts are so interdependent that every aspect must be working smoothly if the system is to work effectively. Court automation can relieve employees of job stress and increase their effectiveness if time is taken to design the system well, the system is flexible enough to adapt to changing local conditions, and employees are properly trained. Since the employer will place a premium on the productivity of the new system, employees may need to consider protections against the setting of unrealistic or simplistic work standards.

Corrections officers. New equipment for electronic surveillance and new building designs will promote the use of technology to control inmate behavior. These new devices may make the prison of the future one in which prisoners and corrections officers are far less frequently in physical contact than is the case today. The physical safety of corrections officers may be improved, but the professional job requirements and skills required of corrections officers may change. New x-ray equipment for screening people and materials entering the prison may protect employees from criminal behavior, but safeguards must be taken so that new safety risks, from the machinery itself, are controlled.

Meter readers. Some jurisdictions have already begun experimenting with electronic meter reading. Readings could be taken by remote scanning from a truck, or through direct link-up with cable television systems. Once the infrastructure of cable connections is pervasive, electronic reading of utility meters may become economically feasible on a wide scale.

CHAPTER 3 - DEVELOPING A UNION STRATEGY

Should new machinery at the workplace be welcomed or resisted? Sometimes new technology can make work easier, cleaner, and more comfortable. But in many cases, people will be uncertain and possibly fearful of the impact of new technologies on their job security and working conditions.

Sometimes, these fears will be ungrounded or exaggerated. Fear and uncertainty may come from poor communication by management. Management tends to make arbitrary plans, without consulting or even informing employees, so that an unnecessary conflict may be created. If this is the case, the union's main role may be to pressure management to consult with the union, to keep employees informed in a timely fashion, to properly train employees on new equipment and in general to implement plans in a way that makes sense to the employees affected. These are all things that managers are supposed to do, but often do not.

Unfortunately, there are times when new technology presents a very real threat. In this case, the union's role is much tougher. It involves negotiating strong contract protections (see Chapter 4), and putting pressure on the employer by highlighting the unfair impact of its plans on employees, possible health and safety dangers, and inaccuracies in management's calculations of the true costs and benefits of its plans.

The following is a checklist of potential concerns to help the union develop a comprehensive and sensible strategy for dealing with new technology.

Evaluating Management's Plans

a) What departments or positions are targets for change?

This may be revealed through rumor, informal contacts, labor-management meetings, or as a result of management compliance with the advance notice and consultation provisions of the contract. In addition, here are some areas that are likely targets for today's new technologies:

- All information-handling jobs. Jobs in which there is a large element of routine in the way information is handled are often affected. Tasks which involve the processing of information - that is, the stage of information handling in which raw data are coded, combined, condensed or otherwise manipulated for later use in making decisions - are easily handled by the microprocessor. Jobs that involve monitoring the condition of equipment or patients are also likely to be affected. Most professionals will find it necessary by the end of this decade to use computers to help them make judgments and keep track of cases.

- Jobs in which there are shortages of workers with necessary skills, and areas in which there are bottle-necks in the provision of services.

- Functions in which costs, especially labor costs, are rising faster than average.

- Areas in which service is slowing down due to increasing demand or the increasing complexity of the work.

- Jobs in which current equipment is old or worn out, if the employer has the resources needed for new investment.

b) What are management's goals for introducing new technology- improving services or cutting costs?

This may not be a clear-cut "either/or" choice in many cases. Still, it is important to have some idea of whether new technology and the way it is used will have the effect of expanding, maintaining, or reducing service quality and quantity, and whether expenditures will be cut, maintained, or increased. If the application of new technology is service-oriented, it may not have the negative effects on jobs and wages that a cost-cutting application of technology can have. Even where technology is introduced in a completely positive fashion to expand services, however, the union will still have to fight to share in the benefits of the new technology (easier, more comfortable work, training and upgrading of current employees, etc.).

c) What is the timetable for introducing new technology?

Obviously, the earlier the union finds out about management plans, the better for developing a union strategy. There are key points at which important decisions are made and after which it becomes more difficult to reverse the process. These include: 1) deciding to use technology as at least part of the solution to a problem; 2) choosing a particular brand of equipment; 3) commiting funds to purchasing the new equipment; 4) putting the technology into use. The timetable should also include a trial period, which provides a small scale test of the feasibility of the new technology and a chance for the union and management to observe the new system in operation before making permanent decisions on work rules, training, wage rates, and health and safety protections.

In the early stages, it may be possible to persuade management that costly new technology is not the appropriate response; better staffing, improved working conditions and other concrete steps that emphasize the valuable role of human beings in improving services and productivity could be more effective. (On the other hand, it may be appropriate for the union to suggest investment in new equipment in some areas -- for example, when management thinks a cheaper solution is to push employees harder or contract out work, or when old equipment is unsafe or ineffective.) In later stages, the union may want to suggest that management experiment with particular kinds of equipment that are easier and safer to operate or suggest work arrangements that will be more beneficial to employees. Perhaps management can be persuaded it could avoid grievances and poor morale by coming to an agreement with the union which provides certain protections and benefits to employees.

d) How thorough has the management analysis been?

The union may be able to point out areas in which management has underestimated costs or overestimated benefits. Perhaps the problem will not really be solved with the new technology or there may be some basic practical flaw with using the new equipment in a particular situation (such as using large trash bins with wheels on hilly, narrow streets in cities in snowy climates.) Has management considered the capacity of the new technology to create new problems in areas such as employee morale, safety and health, and client satisfaction?

Assessing the Impact on Jobs

a) Will jobs be made easier or more difficult with the introduction of the new technology?

New technology can make work harder by making the following things possible:

- speeding up the pace of work;
- tighter supervision;
- Machine recording of work time and work output;
- increasing the amount of time worked each day by cutting into scheduled breaks or reducing the ability to take informal breaks;
- making work more boring by oversimplifying tasks or reducing the scope of a job to a small number of routines controlled by the machine.

b) Will the new technology add to new health and safety hazards, or help reduce those of the old job?

Safety and health risks may be increased by introducing poorly designed equipment or new chemicals into the work environment. Also, the employer may choose to organize work around the new technology in such a way as to increase stress-related discomforts and diseases.

If new health and safety hazards are possible they must be detailed. What part of the new equipment is responsible? What are ways to reduce or eliminate the hazards?

c) Will job requirements be changed by new technology?

Changing job requirements can have consequences for both workers and the union as an organization. The main concerns for workers are:

- changes in character or level of skills required for job performance;
- appropriate training standards for operating new equipment;
- commitment to training current employees for jobs that are at least equivalent in skill level to old jobs;
- new opportunities (or threats) for career ladders and promotions.

The union as an organization may find that new technology can be used to reorganize work out of the bargaining unit, or bring it into conflict with another union's jurisdiction.

d) Will jobs be lost?

If the number of jobs will be reduced with the introduction of new technology, the transition can be made easier by absorbing cutbacks through attrition or by transferring employees to other areas. Consideration should be given to retraining, preferential transfer rights, and generous severance benefits with sufficient advance notice of layoff to make the transition to new work easier.

e) Will wages and salaries change?

If there is higher employee productivity with the new technology, wages should be increased to reflect this. On the other hand, new technology may enable the employer to pursue a long-term strategy of holding wages down by recruiting less-skilled employees or by replacing human labor with machines. If jobs are restructured to pay less, current employees will need some kind of wage protection.

The Union Dilemma

In most situations, new technology will not be all good or all bad. Nor is it likely that union pressure will produce the desired response on every issue. New equipment may improve the working conditions of current employees, but at the expense of reductions in the overall number of jobs. Whatever the problems with new technology, some alternatives may be even worse. Using new technology in-house is, for example, preferable to contracting out an entire operation.

New technology can be a boon for all parties - employer, employee, client, and the public. It is up to the union to fight for protections. Employees should not have to bear all the costs of implementation and adjustment to the new ways of doing work.

CHAPTER 4 - CONTRACT PROTECTIONS

Many contracts already have language that can be used to deal with new technology. Although a specific "new technology" clause may not exist, contract protections may exist in "job reclassification" or "work reorganization" clauses. Contract language originally developed to deal with issues such as safety and health, layoffs, and the impact of civil service reorganization can all be relevant.

What follows is a list of contract areas that may be useful for dealing with problems with new technology. Ideal contract language is, of course, often far different from what can be achieved in actual negotiations. Examples of language that AFSCME locals around the country have negotiated in response to new technology are included in Appendix A.

To Negotiate or Not?

The contract is an important source of protection for AFSCME members. When proposing new language, however, some caution should be taken about creating a bargaining history which could be considered by an arbitrator. For example, if a specific issue is discussed at the bargaining table and then dropped, the union may not be able to pursue a grievance. Therefore, when bringing up a new technology issue at the bargaining table, consider whether there is any existing language in the contract that may be used to cover the situation. If it is probable that it is already covered, test it out before the next contract negotiations begin. If the issue proves not to be covered by existing language, propose more precise language in the next negotiations.

Recognition

If the bargaining unit is defined in terms of the specific job titles of covered employees, the unit may be eroded as jobs are reclassified, eliminated, and new jobs established. It is preferable to define the unit by department (such as "all nonsupervisory employees in the Public Works Department"), by function ("all repair and maintenance workers" or "all clerical employees") or by exclusion ("all employees in the City except the following...").

There are some agreements which specify that "any new positions which perform work or functions historically performed within the bargaining unit shall fall within the jurisdiction of the Union."

Since new technology can often simplify work or reduce the amount of labor required for jobs, management may use the introduction of new technology to increase the use of part-time workers. Adding contract coverage for part-timers or prohibiting the use of part-timers may become important issues. The contract should specify that part-timers will receive as many full benefits as possible (pro-rated, at the least) so that management's incentive to use them will be reduced.

Advance Notice

Advance notice of technological change is essential if the union is to develop an effective strategy and gather the information needed to influence its implementation. Three main issues should be considered in drawing up the most desirable clause. First, while it may not be necessary to receive notice of all new technology (For example, is the latest computerized typewriter or mechanized garbage truck "new" technology?), there should be notice of all new technology that may have a significant impact on work, job and wage security. New technology could be defined in the contract as "any change in equipment and/or work methods that may have a significant impact on wages, working conditions, job security, the way in which work is performed, and/or the size of the bargaining unit." Second, it would be useful to receive notice before a final decision is made or before new equipment is purchased rather than immediately prior to actual implementation. Finally, it is probably better to require notification a specific number of days in advance (e.g., 60 or 90 days), rather than to have a vague deadline of "reasonable" notification.

Sample notification language could read:

> "Should the Employer intend to institute any new equipment or methods of operation that may result in a material change in any job presently covered by this Agreement, the Employer shall give at least 90 days written advance notice to the union before making a final decision to implement such changes. The written notice will set forth the nature of the intended changes and their probable effect on the jobs and employees covered by this Agreement."

Consultation

Once notice is given, the union should be able to comment on management's plans before implementation. It would benefit the union to require negotiations on the issues of wage rates, job classification, work rules, impact on the bargaining unit, and treatment of displaced employees, if possible. Impasses on these issues should be subject to arbitration. A labor-management committee could be set up to discuss issues, problems, and plans in many areas, including new technology.

Sample consultation language could read:

> "The parties shall confer on the effects of new technology and reorganization prior to implementation. The parties shall, if they agree, fix fair, just, and equitable terms and conditions of employment under the new operations. If the parties are unable to agree, the matter shall be submitted to arbitration in accordance with the terms of this agreement. The arbitrator's decision shall be final and binding."

Trial Period

A trial period to observe the new system in operation is very important. This allows the union to see the system in place before committing itself to accepting certain work rules, job classifications, and wage rates. Upon completion of the trial period, the contract could specify that agreements on items such as wage rates and job classifications would be retroactive to the initial date of implementation.

Sample trial period language could read:

> "The Employer agrees to meet with Union representatives to set up a three-month trial period for using the new technology or working under changed operations. It will be the Employer's policy not to create any abnormally heavy workload or safety or health hazard; however, if the Union alleges in good faith that the changes put into effect during the trial period have had such an effect, then that issue may be submitted by the Union directly to the last step of the grievance procedure. The parties shall not reach final and binding agreements concerning the introduction and operation of new equipment and methods until the completion of the trial period."

Reclassification/New Classification

Contract language on job classification can provide substantial protection if it calls for negotiating wage rates for new classifications and the inclusion of new or changed positions in the bargaining unit. At the least, management's action in these areas should be grievable.

Sample language on reclassifications and new classifications could read:

> "Work currently performed by bargaining unit employees will continue to be performed by employees within the

bargaining unit, even where the introduction of new methods or equipment may alter the character of jobs currently held by bargaining unit employees."

"The employer will negotiate with the Union over the appropriate classification and wage rate for jobs that are changed or newly created by the introduction of new methods or equipment. Where the parties fail to agree on the appropriate wage rates and classification within sixty days of implementation, either side may submit the matter to final and binding arbitration before a neutral third party."

Training

Adequate training in the safe and effective operation of new equipment should be provided. Employees should also have the right to training for other positions if jobs on the new equipment are unavailable or undesirable. Training costs should be paid for by the employer; the employee should be paid for time spent in training, even if training occurs outside of regular working hours.

Sample language on training could read:

"If any technological change alters the tasks and/or skills required of any person in a job, or if any technological change permanently displaces any person in the performance of a job, the Employer agrees to provide training for that person, at the Employer's expense, for a new job resulting from the technological change or for another equivalent job."

"Any person offered this training shall have the right to reject it, but the offer shall discharge the Employer's obligations under this section unless the job opportunity for which Employer offered training was at a lower rate of pay than the job previously held by the employee."

Wage Security

Employees should suffer no loss in pay because of the introduction of new technology.

An example of wage security language is:

No employee shall suffer a reduction in pay because of the introduction of new equipment or new methods."

Job Security

The existing contract may already contain protections and regulations concerning job security. The role of seniority in layoffs, severance pay, preferential re-hiring of laid-off workers and possible alternatives to layoffs (such as reduction in hours) are all areas of concern to the union for many reasons, including technological change.

Some contracts prohibit outright the elimination of jobs through technological change. Such language can read "No position will be eliminated as a result of the introduction of new technology."

Workers affected by new technology should have transfer rights to new or vacant positions, at no loss of pay and with training provided. A special kind of severance pay could also be proposed to pay for an employee's retraining and relocation, even if the retraining is for a position or occupation completely unrelated to the current employer. This may assist employees in those cases in which the current employer has no available positions.

Safety and Health

Safety and health clauses should, of course, protect employees from the hazards of current equipment and working conditions, as well as new. The basic provisions of safety and health protection include:

- management is obligated to provide a safe and healthy work environment;
- safety and health issues are grievable;
- workers have the right to refuse work they believe to be unsafe;
- management and the union should meet periodically to discuss safety and health issues and attempt to resolve them before the hazard results in serious harm;
- management is required to provide the auxiliary equipment necessary for the safe and healthy performance of work.

Arbitration Over New Technology

Introducing new technology and new methods of work have long been considered basic management rights. In the absence of specific contract language that places some limits on these rights, arbitrators are likely to decide for management on grievances over new technology. In a 1979 study, Doris McLaughlin and Christine Miller analyzed arbitration cases concerned with new technology, and concluded that:

> "When the unions won it was due to specific contract language which stipulated who did what work, the extent to which the purpose of that work must be altered by new processes or machinery to warrant assignment of the work to different employees, how

> and under what conditions the workforce would be reduced, and how the negative effects of technological innovation would be compensated for or ameliorated. Unions won on the issues of work assignments, scope of bargaining unit, termination of employment, and rates of pay.
>
> The cases unions lost were on those same issues, but in each of those cases relevant contract language was either non-existent or too weak to protect them. Management victories were attributable either to arbitral reliance on management rights clauses or principles which, in the absence of specific and restrictive contract language, permitted the employer to introduce technological innovation, combine or eliminate jobs, assign work, set rates of pay and determine crew size as demanded by business needs or objectives. More simply stated, arbitrators appear generally to interpret specific contract language narrowly in technological change cases and to interpret management rights clauses broadly".

AFSCME locals have been involved in a number of successful arbitrations. The outcome of an arbitration often depends on a unique combination of contract language, local circumstances, bargaining history and even local labor laws and civil service regulations, so results may not be generalizable to other situations. However, AFSCME locals have successfully won several kinds of technology cases, including upgradings for word processing operators, and adding new groups of word processing employees to existing bargaining units.

THE AFSCME APPROACH

Bargaining over new technology is difficult, full of pitfalls and tradeoffs. Having the best equipment possible can allow more efficient and effective delivery of services. But workers should share the benefits of higher productivity, without fear of downgrading or unemployment. AFSCME wants technology applied in ways which will benefit the people we represent, as well as the public we serve. Technology must be used to expand skills and responsibilities, not narrow them; to expand the services provided to the public, not reduce them; and to affirm the worker's role in providing public services, not eliminate it.

Preparation is essential if the benefits of new technology for workers are to outweigh the costs. Rather than wait until the problems of technology have become evident, the union must study and research the potential of new equipment and new work methods for both good and ill in a particular situation.

The union can set up its own technology committee. Such a committee can keep a watchful eye on developments in fields relevant to the local and set up programs to educate members about technology. The committee can administer surveys to members concerned about technology, address the questions raised in this guide and make suggestions about strategies to pursue at the bargaining table and elsewhere.

This guide has been designed to raise new technology issues that will be of general concern to most AFSCME members. More detailed information on specific topics is available and the resources listed in Appendix C may be of use in finding it. Your staff representative can also be of help or can contact the International for additional assistance.

APPENDIX A

SAMPLE TECHNOLOGY CLAUSES NEGOTIATED BY AFSCME LOCALS

1. Negotiation over wage rates

Where new types of equipment are to be utilized or new operations are to be adopted, the Municipality shall notify the Union of the proposed new equipment or new operation and of the proposed wage schedules for employees within the bargaining unit to be engaged in operating the new equipment or to be involved in the new operation. If the Union disagrees with the proposed wage schedules, the wage schedules shall be immediately referred for collective bargaining between the parties.

City of Wauwatosa, Wisconsin and Local 305, Council 48

2. Job and wage security, training

AUTOMATION

The Union shall be kept currently informed of the Library's program for automation. No staff member shall be involuntarily terminated or demoted as the result of the introduction of automation to the Library's services or procedures. When services or procedures are automated, the Library will make every effort to train staff members assigned to the performance of those services or procedures.

New York Public Library and Local 1930, Council 37

3. Training, using current employees in new jobs, wage security

TECHNOLOGICAL CHANGES

A. The Employer and the Union recognize that changes in operations resulting from technological innovations may occur. When such changes occur, the Employer shall give first consideration to the utilization of affected Employees in the changed operations. In the event the affected Employees do not possess the requisite skills or knowledge to perform the required work in the new operation and such skills and knowledge can be acquired within a reasonable length of time, the Employer shall provide the necessary training to Employees during working hours and at the Employer's expense.

B. If the job af any Employee is eliminated because of the implementation of new technological innovations, the Employer shall, in the following order of priority: 1) place the Employee in a position comparable in level to his original position; 2) place the Employee in a lower level position provided that he shall retain his existing rate of compensation so long as he remains in the position; or 3) follow the procedure under Article 9, Reduction-In-Force.

C. Any Employee affected by this Article shall be required to meet the minimum qualification requirements for the class in which he may be placed.

State of Hawaii and Professional and Scientific Unit, Local 152

4. Advance notice, consultation

REORGANIZATION AND/OR AUTOMATION

Employees shall be kept informed of the Library's programs of reorganization and/or automation. Current employees required to perform automated functions shall be given the necessary training at the Library's expense. The Union will be provided timely notification of any reorganization or automation plans that affect the bargaining unit. No reorganization or automation shall be effected without prior consultation.

District of Columbia Public Library and Local 1808, Council 20

5. Job and wage security

Automation

No staff member shall be involuntarily terminated or reduced in salary as a result of the introduction of automation to the Library's services or procedures.

Brooklyn Public Library and Local 1482, Council 37

6. Negotiation over wage rates

New Operations and Equipment

Where new types of equipment are utilized or new operations are established which was not being used or performed by the Board at the time of the execution of this Agreement, the wage rates to be paid the employees assigned to this equipment and these operations and the job descriptions shall be agreed upon between the parties within sixty (60) days after institution of new equipment or new operations. Such wage shall be retroactive to the first day of use.

South Milwaukee Board of Education and Local 883, Council 48

7. Wage premium for word processing operators

LETTER OF AGREEMENT

In RECOGNITION OF the use of word processing and computer peripheral machines throughout the institution by AFSCME 2172 members which results in technological advancement; and,

IN RECOGNITION OF other increased productivity and flexibility provided the College through the negotiated understanding regarding use of Temporary Assignments;

THE COLLEGE SHALL make a wage adjustment for each AFSCME 2172 member in the amount of $200 per Employee, added to the base salary, effective January 1, 1982, and in the amount of $100 per Employee, added to the base salary, effective January 1, 1983.

IT IS FURTHER RECOGNIZED THAT the negotiated classification/reclassification system provides opportunities for mobility which is a positive step toward meeting the objectives of the Board of Trustees which resulted from the recommendations of the Equal Employment Opportunity Task Force.

Macomb County Community College, Michigan and Local 2172, Council 25

8. Wage premium for word processing operators

B. When an employee in the class of Clerk Typist or Clerk Stenographer, is regularly assigned to operate a remote data entry and recall system (e.g., Video 370

CRT), or is assigned to operate such system more than 50% of his/her time in any one day, such employee shall receive salary at the third premium level rate (8.25%) above the appropriate step rate of the salary range for his/her class for each day so assigned.

C. When an employee in the class of Library Assistant I, or Senior Clerk Typist who is regularly assigned to the Police Department Records and Identification Division or Automated Information Division, Operations Support Unit, is regularly assigned to operate a remote data entry and recall system (e.g., Video 370 CRT), such employee shall receive salary at the first premium level rate (2.75%) above the appropriate step rate of the salary range for his/her class. This note is effective commencing with the first payroll period following implementation of the Memorandum of Understanding.

D. When an employee in the class of Clerk Typist or Clerk Stenographer is regularly assigned to operate word processing text editing equipment or is assigned to operate such equipment more than 50% of his/her time in any one day, such employee shall receive salary at the third premium level (8.25%) above the appropriate step rate of the salary range for his/her class for each day so assigned during the first six months of such assignment.

Employees in the class of Legal Clerk II, Legal Secretary I and Senior Legal Clerk I shall be included in this note commencing with the first payroll period following implementation of the MOU.

Upon successful completion of a six-month training program in word processing equipment operation, such employees in the above-named classes shall receive salary at the fifth premium level rate (13.75%) above the appropriate step rate of the salary range for his/her class for each day so assigned.

E. When an employee in the class of Senior Clerk Typist, Senior Clerk Stenographer, Library Assistant I, Legal Secretary II or Senior Legal Clerk II is regularly assigned to operate word processing text editing equipment, or is assigned to operate such equipment more than 50% of the time in any one day, such employee shall receive salary at the third premium level rate (8.25%) above the appropriate step rate of the salary range for his/her class for each day so assigned.

F. When an employee in the class of Senior Clerk Typist or Library Assistant I, is regulary assigned to supervise remote data entry and recall operations more than 50% of his or her time, such employee shall receive salary at the third premium level rate (8.25%) above the appropriate step rate of the salary range for his or her class.

G. When an employee in the class of Senior Clerk Typist, Senior Clerk Stenographer, Library Assistant I, Senior Legal Clerk II, or Legal Secretary II is regularly assigned to supervise word processing text editing operations full time, such employee shall receive salary at the fifth premium level rate (13.75%) above the appropriate step rate of the salary range for his/her class. This note is effective commencing with the first payroll period following the implementation of the MOU.

H. An employee in the class of Legal Secretary III or Library Assistant II, regularly assigned to supervise remote data entry and recall operations full time, including the training of subordinates and monitoring of the work flow, shall receive salary at the third premium level rate (8.25%) above the appropriate step rate of the salary range for his/her class. This note is effective commencing with the first payroll period following implementation of the MOU.

I. An employee in the class of Legal Secretary III or Library Assistant II, regularly assigned to supervise word processing text editing operations full time, including the training of subordinates and the monitoring of the work flow, shall receive salary at the fifth premium level rate (13.75%) above the appropriate step rate of the salary range for his/her class. This note is effective commencing with the first payroll period following implementation of the MOU.

Los Angeles City and Clerical Unit Local 3090, Council 36

9. Trial period, negotiation and arbitration

Supercan Refuse Collection: Each regular work day employees assigned to supercan shall be responsible for the satisfactory completion of the scheduled route. Upon satisfactory completion of the daily assignment, employees shall be considered to have completed their day.

Any necessary equalization of route structure shall be considered in accordance with the recommendation of the Route Monitors as provided in the Section on Route Monitors.

The normal work week for employees assigned to supercan shall be administered on experimental schedules in the manner described above for twelve (12) months from the effective date of this Agreement. The purpose of having experimental schedules is to collect data on collection and routes to determine the most efficient, effective and balanced method. Management and the Union will consult on the implementation of a mutually agreeable system based on the experimental findings at the end of the test period. If the parties cannot agree the Union may request negotiations by giving the Employer written notice no later than ten (10) days after the determination is made that no mutually agreeable system can be reached. If no settlement is reached within thirty (30) days after negotiations have commenced, either party may submit the issue to arbitration.

District of Columbia Department of Environmental Services and
Local 2091, Council 20

APPENDIX B

AFSCME RESOLUTIONS ON TECHNOLOGY

(25th International Convention,
Atlantic City, New Jersey, 1982)

NEW TECHNOLOGY IN THE WORKPLACE

WHEREAS:

New technology, properly implemented, offers potential benefits to workers and the public. These benefits include: safer and more comfortable working conditions, the opportunity to learn new skills and perform more skilled work, more efficient delivery of services and the freeing of resources to expand and improve services. In spite of the potential, experience shows that often jobs are made more routine, more unskilled, more unhealthy, lower-paying and more dead-end with the introduction of new technology.

WHEREAS:

New technology is changing working conditions for thousands of AFSCME members. For example, the spreading use of video display terminals in offices speeds the pace of work while exposing the worker to new health hazards; mechanized refuse collection results in smaller crew size and reduced service; computerization of information services threatens to downgrade the pay and training requirements for librarians. No clerical, blue-collar or professional occupation will be unaffected by the technologies of the 1980's.

THEREFORE BE IT RESOLVED THAT:

AFSCME councils and locals will negotiate about the introduction of new technology that will affect the job security, pay or working conditions of AFSCME members. AFSCME will encourage the use of trial periods and the advance notification to allow time for careful implementation of untried technology, so that the interests of those who must work with the new technology are respected. Experiments in job security, retraining and career development may be necessary to protect members from adverse impact. The productivity gains made possible by new technology should be shared by the workers who are more productive, in the form of higher wages, better working conditions and improved job security.

BE IT FURTHER RESOLVED:

AFSCME will support technologies that are designed to improve and expand public services, and will oppose technologies that are introduced mainly to inappropriately speed up the pace of work, or used as a smokescreen for the reduction of services.

AFSCME will encourage an investigation by the AFL-CIO and the Federal Government to determine the impact of technological change on employment, income and working conditions of all workers with the ultimate aim of developing national policy and programs for dealing with technological change and its effects.

POTENTIAL HEALTH HAZARDS OF VIDEO DISPLAY TERMINALS

WHEREAS:

In this computer age, video display terminals (VDT's) are becoming as common as the sturdy, old manual typewriters of yesteryear.

WHEREAS:

Approximately 7 million American workers are using video display terminals for as many as seven hours a day, five days a week with very little break away from the terminals; and this number of workers is climbing at a rapid rate.

WHEREAS:

Many of these American workers are complaining about back pains, muscular aches, eyestrain, and irritability, brought on by tension and a few of the complainants even linked radiation exposure from VDT's to early cataract and birth defects.

WHEREAS:

The scientific studies on radiation exposure from VDT's are few and not reliable; and further investigation of health effects of radiation in the VDT frequency range seems advisable.

WHEREAS:

There have been several instances of women, working on VDT's, giving birth to babies with birth defects.

THEREFORE BE IT RESOLVED:

That AFSCME take an active role in encouraging adequate training provided by the employer and monitoring laboratory research of the health hazards of video display terminals in areas such as Workstation Design; Illumination and glare control; visual testing criteria; rest breaks; and radiation exposure (radiation research being top priority). The results of such research be provided to employees and throughout the union.

APPENDIX C

ADDITIONAL RESOURCES

AFSCME has a number of publications related to new technology issues, including Health and Safety in the Workplace: An AFSCME Handbook, Warning: Office Work May Be Hazardous to Your Health, and Health Care Hazards and How to Control Them: An AFSCME Guide for Hospital and Health Care Workers.

The following magazine articles and reports may also provide useful information for your situation:

General

1. Chamot, Dennis, editor. "Technological Change and Unions: An International Perspective," published by the Department for Professional Employees, AFL-CIO, August, 1982.
2. General Accounting Office. Advances in Automation Prompt Concern Over Increased U.S. Unemployment, May 25, 1982. GAO/AFMD-82-44.
3. "Jobs: Putting America Back to Work," Newsweek, October 18, 1982, pp. 78-84.
4. Kennedy, Donald, Craypo, Charles, and Lehman, Mary, editors. Labor and Technology: Union Response to Changing Environments, Department of Labor Studies, Pennsylvania State University, 1982.
5. Levitan, Sar and Johnson, Clifford. "The future of work: does it belong to us or to the robots?" Monthly Labor Review, September, 1982, pp. 10-14.
6. Murphy, Kevin. "Technological Change Clauses in Collective Bargaining Agreements," published by the Department for Professional Employees, August 1981.
7. "New Technology: Who Will Control It?" American Labor, Issue #13, 1981.
8. Office of Technology Assessment, U.S. Congress. Automation and the Workplace: Selected Labor, Education, and Training Issues, Congress of the United States, March, 1983.

9. "The Speedup in Automation," Business Week, August 3, 1981, pp. 58-67.

10. Stokes, Henry Scott. "Japan's Love Affair with the Robot," The New York Times Magazine, January 10, 1982.

Computers and VDTs

1. Garson, Barbara. "The Electronic Office: Scanning the Office of the Future," Mother Jones, July 1981, pp. 32-41.

2. "If home is where the worker is," Business Week, May 3, 1982, p. 66.

3. "The instant offshore office," Business Week, March 15, 1982, pp. 136E-137E.

4. National Institute of Occupational Safety and Health. Potential Health Hazards of Video Display Terminals, June, 1981.

5. New York Committee for Occupational Safety and Health. Health Protection for Operators of VDTs/CRTs, 1980.

6. Norman, Colin. Microelectronics at Work: Productivity and Jobs in the World Economy, Worldwatch Institute Paper #39, October, 1980.

7. Salmons, Sandra. "The Debate over the Electronic Office," The New York Times Magazine, November 14, 1982.

8. Shaiken, Harley. "Computers as Strikebreakers," Technology Review, April, 1982, pp. 50-51.

9. Sorensen, Jeff and Swan, Jon. "VDTs: The Overlooked Story Right in the Newsroom," Columbia Journalism Review, January/February, 1981, pp. 32-38.

10. Zuboff, Shoshana. "New Worlds of Computer - Mediated Work," Harvard Business Review, September/October, 1982, pp. 142-152.

Health Care -

1. Kernaghan, Salviniji G. "Managing the Products of Automation," Hospitals, August 16, 1982, pp. 75-79.

2. "Military Tests Automated Health Care," Hospitals, July 1, 1982, pp. 35-36.

3. Thompson, Karen. "The Impact of New Technology on the Health Care Professional," published by the Department for Professional Employees, AFL-CIO, November, 1982.

4. "The ways, they are a'changing," Hospitals, January 1, 1983, pp. 92-103.

Courts

1. Kuykendall, C. Mae and Popp, William H. "Computers and the Courts," State Court Journal, Summer, 1977, pp. 6-11.

2. National Center for State Courts, "Data Processing and the Courts: Guide for Court Managers," September, 1977.

3. Polansky, Larry. "Contemporary Automation in the Courts," Proceedings of the Second International Symposium on Criminal Justice Information and Statistics Systems, 1974, pp. 409-422.

Libraries

1. Library Journal, June 1, 1982, Special issue on new technology in libraries.

Correction Facilities and Jails

1. Bateman, John P., "X-Ray Screening Systems," Corrections Today, April, 1983, pp. 20-24.

2. Nelson, William 'Ray'. "New Generation Jails," Corrections Today, April, 1983, pp. 108-112.

Refuse Collection

1. "One Plus One is Greater Than Two," Refuse Report, January/February/March 1977.

2. "Roll Out the Refuse Carts," The American City and County, January, 1979, pp. 61-62.

3. "Whatever Happened to Garbagemen?" The American City and County, May, 1978, pp. 49-53.

Ms. **Lampkin**. For example, in chapter 4, under the "Recognition" clause, we have a problem with part-timers. If technology and automation are going to lead to more use of part-timers, we have to make sure that they have bargaining rights and that we are able to protect them—advance notice of technological change, consultation over the change, a trial period for the implementation of new equipment—reclassification and new classification language detailing those kinds of things.

Again, our overall position is we are not opposed to technology, but we are very concerned about how it is applied. We want to be as involved as possible in the work redesign aspects, and the whole area of career ladders, appropriate training and retraining and job security issues.

Mr. **Walgren**. Let me ask Mr. Williams sort of the same question, whether you could elaborate on some of the contract goals? And then to both of you the question: Have you had any experience of how successful or how helpful these kinds of measures have been, even though I understand it is sort of new in the contract bargaining area? But do you have any experience you can share with us as to whether or not this really solves some problems that we should be thinking about?

Mr. **Williams**. The contract items to which I made reference in my paper are really defensive contract items. I meant things like the kinds of pension arrangements we put together so, when there is a decline of employment, full pensions are triggered at lower ages and with less service, and so on, so people can get out on a pension. That has been very helpful in the circumstances.

Mr. **Walgren**. Has that been our experience thus far?

Mr. **Williams**. That is a defensive strategy. It enables people to be unemployed and do better than they would do if they were out of the plants.

We have also had contract provisions that enable transfers to other plants in the same firm which, up until the recession were reasonably helpful, but there aren't many other jobs at other plants at this stage, so that hasn't been so useful recently.

The more offensive strategies which we would like to be involved, like pressing much more vigorously for advance notice, we do have some advance notice in the basic steel contracts, but not as extensively as we would like. Or like pushing for much more consultation or pushing for much more involvement in training and retraining programs. Of course, you move ahead in collective bargaining in periods when your bargaining strength is strong, and we haven't been in that kind of position. We have been in a position where our bargaining strategy has been much more directed toward survival than to moving out into new areas. So there is, I must say, a serious gap between our objectives in those areas and what we have been really able to accomplish.

Mr. **Walgren**. Yes.

Mr. **Williams**. If there is one program that has helped, it is in those places where we have been experimenting with what we call labor-management participation teams, which is a quality of work life kind of program, which we did under our 1980 agreement experimentally and in which, in our 1983 agreement, this year's agreement, we have made a much more firm and definite program.

In those areas where we have a whole arrangement of consultation and involvement in the plant from the level of the management and the local union officers right down to the shop floor itself, and a much better means of communication and of the workers being involved in the problems of the plant and being in the position to make suggestions, and so on, that is a better mechanism than we have had in place anywhere up until now to deal with technological change.

The great difficulty, of course, is the employment impact. It seems to us that we have to, somehow, move into an approach where technological change and improvement doesn't carry with it unemployment. If people are to be involved, for example, in the design of new processes and developing more efficient ways in which to produce, the normal and natural result—which has been our tradition in this country forever—OK, then there are going to be fewer people working and others are going to be unemployed. We need to somehow turn that around and have an employment commitment. From this new productivity should flow new opportunities.

Mr. WALGREN. Let me ask Mr. Cunningham why he was sort of resisting that point?

Mr. CUNNINGHAM. I don't think it is possible to stay competitive, unless you create something new, unless you have a new opportunity. What you are going to see is—this is a personal opinion—the replacement in some areas being faster than the new opportunities. Also, the new opportunities won't be in the same place that the old activities were. I come from Wales where, for years, they tried to keep uneconomical pits open. That was a real problem.

Mr. WILLIAMS. I think that misses the point. I am not talking about keeping uneconomical pits open. I am saying that if this new technology does provide all of the increased productivity and the increased opportunity to make wealth that it should, then should not the workers in the enterprise in some way be involved and benefiting from that? Should we not then turn to new opportunities.

Mr. WALGREN. Let me just ask whether Mr. Cunningham's point doesn't underscore your statement that there ought to be massive retraining efforts that really do involve more broadly all the sectors of society—including churches, as you indicated—in trying to bring these work opportunities to these unemployed people?

The difficulty I have with that is that, in general, our society has not taken on any responsibility for finding people employment. The bizarre example of that is with the handicapped or with prison population—although we made a little progress with them, but not much. I remember when, not very many years ago, there was a circular passed around the handicapped community which said essentially that there were jobs in St. Louis if anybody could get there. The attractiveness of the poster on the wall had people who hadn't left their basements in 10 and 15 years trying to wonder if they could get to St. Louis. We just haven't filled that function at all. I guess I only underscore that to demonstrate its absence.

The other thing that hit me right between the eyes was, when I was in the practice of law, I ran across a case where a fellow had done a substantial amount of time in a very rough circumstance—

time in prison—and had come out and was working for one of the barge lines in Pittsburgh. There was a slowdown and he was essentially unemployed. His creditors moved on him in a way that was really disorienting to him and, 2 days later, he killed his wife and his mother-in-law and then himself.

My point is simply that it seems to me that we needed our heads examined for having anybody with his record unemployed. Yet, we don't even pick up on mandatory work programs the people who are going to do a lot of damage. We do less for the people that these employment programs are designed—or we thought—CETA and the like were designed to try to help. I underscore that by its absence.

I will be quiet at that point because I shouldn't go on.

Let me turn to Mr. MacKay and invite him into the discussion.

Mr. **MacKay**. Thank you, Mr. Chairman.

I am sorry that I was late getting here and missed part of the discussion.

It seems to me that all three of the witnesses are saying that they have a great deal of concern about the impact of automation on the groups for which they speak, and they don't want to be seen as trying to block technological change, but they want to try to find ways that it can be accomplished with a minimum of stress.

Where is the Federal role in this? What part of this is subject to private sector negotiations? What part of it needs change in the law? From a Federal standpoint, do we need to set up—I understand that, in France, there is a provision for employers to pay into a fund for retraining so that the fund is already there and they can decide whether they want to, in bigger companies, do the retraining themselves or whether they want to establish industrywide retraining mechanisms, but they have got to pay in either way. It is already thought through ahead of time.

It would seem to me if we are going into a time of rapid change, this kind of thing might be appropriate to look at, just as we now look at unemployment insurance this way. Or perhaps we ought to modify the unemployment insurance program so that that money could be drawn against it for retraining as well as unemployment.

I would like to hear your comments. I hope this is not something you covered that I missed.

Ms. **Lampkin**. The whole retraining thing, I think, is an area that the Federal Government needs to get much more into. Right now we are in a period of decline in Government employment. There is a whole emphasis on trying to trim everywhere and cut back. I am not sure that the private sector can be depended upon to fill that gap.

One of the major problems with training is that you are training people for jobs that aren't going to exist when they finish the training. As Mr. Cunningham said, we can train a whole lot of data processing people, data entry operators, but, pretty soon, there won't be any papers for them to type from onto the machine because that is going to be done already. So, we will have a whole crop of people who are trained for jobs that don't exist with outdated technology.

We somehow have to get ahead 15 years, not 5 years, and train people for jobs that are going to exist in the future, give them the skills to be able to adapt to change. And I don't see private industry being able to focus on that big picture on overall needs of the country. I see a great need for that kind of thinking to go on and overall training programs to be developed to meet those longer range needs.

How it is financed, I think, has got to be worked out. Everybody has a stake in it, not just individual employers, whether they are putting a computer in or they are not. It is an overall societal change that is going to be happening.

Mr. **Williams**. The most fundamental thing that the Federal Government could do, of course, is to restore the Nation to economic health. If that could be done, that makes all of the problems of adjustment much simpler and much easier to handle.

But certainly in the training and retraining area, there is a great deal to be done. I would see the Federal Government's initiative as being directed to providing leadership to bring the total community—as I was suggesting in my paper—being the resources of the total community to bear on these problems. I think there is a big role for the educational institutions, obviously. There is a big role for the private sector, big role for the labor movement, and a big role for organizations like churches and social agencies who have a lot of knowledge about the needs of people and the needs of the various communities. It seems to me we haven't in any imaginative way really challenged all of these groups to come together in anything like a large enough basis to deal with the problems.

I share with my labor colleagues the view that we should try to make retraining as job-specific as we can in terms of the fact that it ought to lead to something, but I am always a little concerned that we not get too hung up with that. In my view, for a person who is suffering through unemployment, it would be so much more useful for them to be learning something—something as useful as possible, of course—but learning something. I would think there would be areas of training, if we applied some imagination to it, that would be general in terms of the new technology in which we are involved.

It surely can't be harmful for anyone to learn a little about being comfortable with computers. The youngsters are all going to be comfortable with computers. I don't think it is beyond the capability of all kinds of people who are unemployed at this moment—far from it—to have some training that would make them comfortable with computers. I don't know exactly what that would lead to. I doubt that anyone does. But it would seem clear to me that we are going to be living in a society where, if you don't know your way around the computer a little bit, you are really not in it.

I would see all that kind of thing. I think there are just enormous opportunities out there. We have all of these talented people with nothing to do, and we should be challenging them with something to learn and to do. From that, I am sure, would flow a good deal more creativity in dealing with our problem.

Mr. **Cunningham**. I just have one comment. I think Ms. Lampkin is absolutely right. When you talk about training for special activities, the question is what special activities. I would like to see general training to prepare people in a number of different areas. There is also education. Education, is what you can do; training is how you do it. So the thing is to find out what you can do, what jobs are open to you, and where those are open. Improved communication will supply that kind of information.

I think also—and again this is an area in which these two people are much more expert—that private organizations should be given incentives to train people. We have a private organization, a small company of about 60 or 70 people—I hope it is growing—and training incentives would be useful to us. There are things that we could do if we had some incentive to do it.

Mr. MacKay. Thank you.

Mr. Walgren. At some level, we don't want to do anything for anybody who is unemployed in our country. The example of the prisons, the fellow who had been in prison, when I talk about that with people, what comes back is, "Well, look, what you are saying is that this person should have a guaranteed job." I said, "That is right, because without that circumstance, he is going to do a lot of damage to some people." They said, "But you are rewarding what he did." In some ways, we don't want to do anything for anybody who is unemployed in this country.

Is that a major problem, from your viewpoints?

Mr. Williams. Sure. But in another way of thinking about that, we always finally do—we always finally spend some money on everybody. We really aren't a society which, in the end, is going to stand around and watch people starve to death. So, why can't we use the resources constructively rather than just defensively at the end of the problems? Why can't we turn that around and have a full employment commitment, and have the Government and everyone involved in really trying to find work, as you are suggesting? We are spending the money anyway, but we spend the money in the end—I suppose most wastefully—in putting people back in prison in supporting them there, rather than providing the opportunity or insuring that there is an opportunity for them to participate constructively.

Mr. Walgren. Yes.

Mr. Williams. We need to go back to a full employment commitment, which we made from time to time, but never in fact put in place.

Mr. Walgren. But there is an underlying feeling in many people that the employment is there; if you are not employed, then that is your fault.

President Reagan came to Pittsburgh and said the jobs are in Florida and someplace else.

Mr. Williams. Do you think anybody believes that, Congressman? Are there really people who think that there are enough jobs out there for all of the people?

We read every few weeks about a plant advertising jobs for 50 or 60 people and having lines of people in the thousands.

Mr. Walgren. But the last sentence in your testimony was that the danger was that—you talked about democratizing the ability to cope with this revolution instead of leaving it to runaway capital in search of exploitable labor resources which, as you say, only magnifies the need for such a policy of discussion and consensus.

I guess my fear is that, in order to pursue the productivity that Mr. Cunningham says must be very paramount, we seem to feel it necessary to drive the system by the lowest labor cost, and not doing anything for the unemployed provides you with the lowest labor costs that are possible in the system.

Mr. **Williams**. The Japanese example, it seems to me, is so instructive, where once you see that employment commitment in place, then you see a remarkable change in attitude on the part of both management and labor toward the whole question of technological change. The labor movement then welcomes it because there isn't any threat to employment involved in it. Then people are interested in seeking it, in learning about it, in employing and in using it. And, instead of it being a threat to workers, as it has always been in America, it is a great positive advantage to workers.

The fact that the employer is required to keep the person employed means that they must turn their minds much more creatively to its use and not look at it simply as a way in which they can lower labor costs by getting along with fewer people, but that they can use it to make all of their people more productive. As Mr. Cunningham's group maintains 60 employees and, as he said, hopefully grows.

Mr. **Walgren**. But they had one advantage, and that was that they assumed that there was an infinite market because they exported. We do not face infinite markets. Given the difficulties of employers' exporting, they then are forced to, in their view, I am sure, drive down their costs at every point.

Mr. **Williams**. The conversation, I guess, becomes fairly philosophical. It is true that they faced an infinite market in a very immediate sense. But I wonder if, in world terms, we really don't, if we only can determine how to seize the opportunity, face an infinite market. It is inconceivable to me that in this society we have produced all of the goods that people would like to have. We have a world out there that would love to achieve our standard of living and which should provide many opportunities. And we have surely a totally infinite market in terms of the quality things of life, in terms of culture and learning and literature and all of the rest.

So, I really think an infinite market does exist in this world if we have a way—that is a fairly philosophical point, I recognize—but if we have a way of putting our heads together. That is what I meant by democratization. We need a process in which the talents of everyone in this society are involved. We need a number of processes, not simply the few corporate heads, or what have you, but the entire society involved in trying to grapple with and resolving these problems.

Mr. **Walgren**. Ms. Lampkin.

Ms. **Lampkin**. If you look at the evolution of the United States from an agricultural economy, where we now have probably the most productive agricultural economy in the world—the United States has really had a commitment to making it very productive. Then manufacturing took up the slack when people left farming and had to move someplace else.

In manufacturing, we are now coming to the state where the technology that we have now is causing a similar kind of dislocation. We are looking for the next place where people are going to be employed, which involves resetting priorities at this stage, I think. We need to figure out what is important to our quality of life and put more resources into those kinds of things rather than just the productive capabilities.

Mr. WALGREN. Mr. MacKay, do you have any other thoughts?

Mr. MACKAY. As long as you are being philosophical, it seems to me that what America is being visited with, now, is a dose of our own medicine. It seems to me we have used technology, at least since World War II, in ways that enabled us to export tremendous quantities of goods at a competitive advantage because we were not harmed by the war as much as our natural competitors were. Now it has come full cycle, and they are exporting, and it is creating the same disruptions and dislocations in our economy that it is in everyone else's economy.

I think one philosophically very good thing about it is that now our minds are being turned in the same direction as everyone else's, which is how can we begin to harness technology in a way that it is not so disruptive and that we can, not only produce greater quantities of things, but that the quality of life for the producer and for everyone can be enhanced.

I wonder, at a philosophical level, what that implies for the role of Government and what that implies for the role of union, and what that implies for the role of all the institutions? I wonder if you have given any thought to that?

You talked about lower hours. Obviously, there are going to be fewer jobs, and we have got to find a way to pass those jobs around, give everyone a feeling of meaning in life, and perhaps even use our education system to train people what to do when they are not working which is one of the great problems in our society. That is where all the crime is committed, and that is where all the great disruptions come, is in our leisure time, which means we really haven't been educating people at all, We have been training them all of these years. That is a function of liberal arts, not science and technology.

Mr. WILLIAMS. My own preference is for employment. I think the natural connection that most people have with the world around them is that they would like to do something, to create something, to particpate in the creation of something. So my own philosophical preference, if you will, is to resolve that problem with employment, with trying to structure our society in a way in which there is an opportunity for everyone to contribute. I would see, however, if that isn't possible, that then surely the logical thing is to go in the direction of reducing hours and sharing what work is available on a broader basis around society. I would share your view—it seems to me there is a limitless market then for education and for opportunities to participate more broadly in the qualitative aspects of life, and opportunities to contribute to the qualitative aspects of life. There ought to be a way to put that together.

Mr. MACKAY. If we mandate lifetime employment, will we have the same need for unions that we have now?

Mr. WILLIAMS. Maybe not exactly the same.

Mr. MACKAY. Maybe we will create unemployment in different areas.

Mr. WILLIAMS. What you have in the labor movement, in my view, is a very significant institution that, by and large, would like to be in a position to contribute a great deal more that has been required by the system, if you will, that has come from the need for workers to defend themselves against the most outrageous aspects of the system against the worst of exploitation and the worst of insecurity. That is from whence the labor movement sprung and that is its fundamental role in that kind of context.

But I think that, by and large, you have a movement that has a lot of ideas about how things should be done. I am sure you heard from labor delegations for years and years and years about how things ought to happen. I think that is reflective of a great desire in the labor movement to have opportunities to contribute more constructively. Therefore, if some of the other needs were looked after, I don't think that would mean a disappearance of the labor movement, I think that would mean an opportunity for the labor movement to be involved much more as a partner, if you will, in terms of economic and social and political development than it has been able to be until now.

We will be around.

Mr. MacKay. Thank you, Mr. Chairman.

Mr. Walgren. Let me recognize Mr. Mineta for any comments at this point.

Mr. Mineta. Mr. Chairman, I am sorry to be late, and I have no comments.

I would like to just thank the witnesses for their presence here today.

Mr. Walgren. At the risk of going on too long—we must get to the next panel—but I wanted to go back to one point, and that was to give Mr. Cunningham an opportunity to expand on any direct suggestions about how we find out what to train people for. You indicated that training is what you do after you know what it is you want them to do, and the real problem is how you determine what you want them to do.

Mr. Cunningham. Exactly.

Mr. Walgren. Can you give us any suggestions as to what the shape of that effort might be? I would only like to underscore that by nothing that our withdrawal from the CETA program was essentially because we did not solve that question very well, and the people who were in the employment and training effort were largely working for muncipalities, local and State governments in replacing other employees and the like and there wasn't much training really going on. Consequently, that program lost its political constituency and was gutted by the present administration. How can we answer that question better?

Mr. Cunningham. I think one of the problems we face right now is that nobody really knows what is going to happen. I am sure that all of the testimonies in these hearings have differed on the subject of what will happen in the future in various job functions and in various impacts of technology. No one knows what is going to be required in the 1990's. Perhaps no one even knows what is going to be required in the late 1980's. That limitation makes it very difficult to decide what to train people for.

Therefore, we have a situation where, instead of training people early in their lives for a lifetime job, we may have, as Mr. Williams has indicated, people having to change three or four or possibly even more times in their working lifetime of 30 to 50 years.

It also seems to me that not enough attention is being paid to people forecasts. There are people in organizations like ours who forecast technological changes and their effects over the next 5 to 7 years. But I do not know of many studies or activities looking at the kinds of people who will be required and the impact of technology from a systems viewpoint on these functions. That is the problem.

People tend to look at computers or terminals or communications, whereas it is the entire system that is affected. For example, the whole financial industry is changing. Therefore, the roles of people in that industry are changing. We are getting rid of tellers and replacing them with other functions.

Essentially, I am making two points. The first is that it seems impossible to determine exactly what training is needed for the future, so we need to have a general framework. The second point is that we need to spend time and money determining what the people requirements are going to be in the future and what impact technology is going to have on people, rather than using our resources on the hard issues, the hard studies.

I am sorry I can't offer anything more constructive, but I think it is a question of more foresight and more planning and then training people generally so that they can go in a variety of directions, rather than training them for one specific thing which may not be there.

Mr. WALGREN. Mr. MacKay.

Mr. MACKAY. I would like to just go back at that point to the philosophical question—or maybe it is not—of looking at the institutions that now exist in our country. What institution exists that would train people the way you contemplate? Would it be vocational education, community colleges, universities? Does an institution now exist that would do that?

Mr. CUNNINGHAM. I am not sure that it will be an institutional activity. I think some of the things we are seeing in the application of technology in education and training are very important and, essentially, could mean Government agencies or companies would be able to participate in that training more if they applied some of these new techniques—some of the things that Control Data Corp. has done, for example. Mr. Norris has had a commitment to the social environment and has led the way in the application of computers and technology to the training environment.

So I am not sure that it is institutional in the sense of a training and education institution. Maybe it is the existing organizations applying new techniques to that function. And if there were incentives for them to provide out-training—that is one thing that is often done for senior-level people—if there were some capabilities for doing out-training for all employees and some incentives for organizations to do that, then I think that might be more effective.

I always have a problem with people on the outside trying to tell people on the inside what to do. "You should train people for this function." The people on the inside of an organization who can see what is happening can say, "Hey, I need people over this way; therefore, let me do the training," rather than closing down an organization and opening a new one, which is what often happens today. I think that that would be a direction to go in.

Mr. MACKAY. Thank you.

Mr. WALGREN. It underscores, though, the lack of emphasis the National Science Foundation has been putting on social sciences. We have not been keeping up in that function. You raise an interesting question as to whether or not they might have a role in promoting studies of the people relationship and potential with respect to future employment. That is something I never raised with them, and it would be interesting to pursue it.

Thank you very much. You have been an interesting group. I think each of you have made a nice contribution. Thank you.

Mr. WALGREN. The second panel is made up of Cheryl Wicks, the personnel manager of Rolm Corp.; Robert Cole, professor of sociology, University of Michigan; and Jeanne Stellman, executive director of Women's Occupational Health Resource Center, Columbia University. We want to thank you for joining us today.

Again, at the outset, let me say that we will try to stay within our approximate 10-minute frame. Your written statements will be made part of the record. We would be pleased to have you communicate to the committee as you feel most effective.

Let's start with Cheryl Wicks, and we will go forward. Welcome to the committee.

[The biographical sketch of Ms. Wicks follows:]

Cheryl Wicks
ROLM CORPORATION
4900 Old Ironsides Drive
Santa Clara, CA 95050

EMPLOYMENT

July 1981 - August 1983 — ROLM Corporation, Santa Clara, California

Personnel Manager -- Responsible for:

1) Cultivating ROLM culture and 2) Attracting and retaining best employees. This is done through the Personnel Systems. 1) Employment (including Affirmative Action). 2) Training and Development. 3) Compensation and Benefits and the 4) Liaison function.

January 1974 - July 1981 — HEWLETT-PACKARD Corporation, Palo Alto, California

1) Personnel Manager at H-P Labs and Stanford Park Division.
2) Employment Supervisor and Records and Benefits Supervisor -- Corporate Offices.
3) Training Manager -- Santa Rosa Division
4) Affirmative Action Coordinator -- Santa Rosa Division
5) Recruiter -- Exempt and Non-Exempt -- Santa Rosa Division
6) Liaison -- Santa Rosa Division and Corporate Offices.

August 1971 - December 1972 — Sonoma County Juvenile Hall, Santa Rosa, California

1) Counselor
2) Supervisor

March 1969 - July 1970 — Fresno County Welfare Department, Fresno, California

1) Social Worker -- Aid to totally disabled

EDUCATION

B.A., Sociology, California State University, Fresno

COMMUNITY ACTIVITIES

Present -- Vice President, Board of Directors, Centre for Living with Dying.

Past -- Personnel Commission -- City of Mountain View

Member, National Women's Political Cacucs
Junior Achievement Advisor
Employment Task Force -- Commission on the Status of Women, Sonoma County
Guest Lecturer -- Various Junior Colleges, Stanford, San Jose State, etc.

STATEMENTS OF CHERYL WICKS, PERSONNEL MANAGER, ROLM CORP.; DR. ROBERT E. COLE, PROFESSOR OF SOCIOLOGY, UNIVERSITY OF MICHIGAN; AND DR. JEANNE STELLMAN, EXECUTIVE DIRECTOR OF WOMEN'S OCCUPATIONAL HEALTH RESOURCE CENTER, COLUMBIA UNIVERSITY

Ms. Wicks. Thank you.

My name is Cheryl Wicks. I am a human resources manager at Rolm Corp. in Santa Clara, Calif. I am going to be talking on the quality of work life. My talk is basically drawing on my industrial experience and discussing the effects of technology on job assignments, individual versus team efforts and rewards, workers' job attitudes, social interactions of workers, and the mental and physical health of the workers in the high-technology industries.

My statement is based on opinion and observation rather than studies and statistics. I have 10 years of experience in high technology in the Silicon Valley in Santa Clara. I have worked for both Hewlett-Packard and Rolm Corp., which are known as role models in the area of human relations.

Listening to the earlier panel, it seems as though automation has created a lot of problems, and I hope that some of the things I can say about high technology and some of the ways that the problems are handled in that industry will be helpful to solving some of those problems.

An advantage of living in the Santa Clara Valley, or Silicon Valley, is that often we have exposure to people who have done studies on high technology in industry and the way the problems are handled. Some of those people are Tom Peters and Bill Ouchi. When I was at Hewlett-Packard, I was actually involved in a study on the quality of worklife.

Prior to coming here, I talked to a variety of workers, as well as managers in Rolm Corp., as well as in other industries, to get their opinions to see if my own opinions and observations over the past 10 years reflected anyone other than myself, and found that what I have to say today is pretty representative of many people in that particular industry.

So, the question is: Is high technology a positive or negative influence on American workers? Is it stress producing? I would have to clarify that stress is not necessarily negative, but sometimes it can be. Stress is ever present—and I have some difficulty delineating what things I had to say today were related to high technology and what things were related to living in a highly industrialized urban area, such as getting in your car and driving to work in the morning is a pretty stressful experience before you ever arrive at work.

Studies have shown that, without some level of stress, workers and people in general tend to become lethargic and disinterested, and at too high a level of stress, people become unfocused, confused and perhaps not very productive in the work environment. It is the job of industry to keep this level in balance for maximum vitality, creativity and productivity in the workplace.

What I have to say today about the stress inducers and the stress reducers turns out to be two sides of the same coin. What some people perceive as a stress inducer, others perceive as stimulating, dynamic, and exciting. So, I will go through the things that I believe produce stress in the work environment.

One of the things that the earlier panel talked about was change, with more automation, more high-technology products. Although, high technology affects most industries and most businesses, as well as Government agencies, it certainly affects our own industry in that change is ever present. This change, as I mentioned earlier, is exciting and dynamic to some people and frustrating to others. Much of this change creates fear, fear of the unknown—"What is to happen next? Will I have a job? Will I be able to learn the additional skills that I need to perform whatever is waiting for me in the future? "

There is also a high level of competition anytime you are in an industry where there are highly educated people in a highly educated area. It is fast paced, which creates sustained stress over a long period of time. There is the fear of skill obsolescence. If you graduated from engineering school 20 years ago, unless you have done something creative and intentional to keep those skills up to date, you are lost. If you were a secretary 10 years ago, perhaps you needed to know how to type, use a telephone and a 10-key adding machine. Today, you are probably using some kind of a work station which is both voice and data communication. You are probably operating a word processor or memory typewriter, a telephone that is more complex than the one you had 10 years ago; perhaps, you are learning to use a sophisticated calculator as well as a computer. That is a lot to learn in a relatively short period of time, and is stress inducing.

Many of the companies in high technology—at least the two that I had worked for—support a system of participative management, which is interesting and exciting. Many people really like the opportunity to creatively solve problems as well as identify what those problems are. And some people would rather not have that responsibility and perform job tasks that are well defined for them.

One of the issues that I mentioned earlier was the contribution of the individual and the contribution of the team. It is my observation that our educational system produces individual contributors much better than it produces team members. That can also produce stress when you are introduced into an environment where you are expected to be a member of the team and always contribute to the good of the overall team as opposed to your own individual contribution.

Another stress inducer is that promotions come relatively quickly. Most people would see that as positive, an opportunity to take on greater responsibility, earn more money, and have many of the better things that the world has to offer. It is also a stress inducer in that many times people are not very experienced and asked to take on responsibilities that they are not very well prepared to do. That is basically my list of stress inducers.

I want to talk a little bit about the stress reducers. Some companies—the company that I work for, Rolm—actually has as a statement of its purpose for being in business four goals. One of those goals is to have a great place to work. We talk about work fun, that the natural state of work can be fun. It doesn't have to be difficult and not fun. Some of the stress reducers are tangible programs, and some of the stress reducers are attitudinal or management style.

First, I would like to talk about some of the tangible programs. They are probably more easily understood and illustrated. Some of the tangible programs that many of the companies in high technology have would be programs such as flexitime, which allows individual employees to maximize their work schedule so that they can have the maximum amount of time with their families or for community activities, or whatever they choose to do.

We also have a program, a continuous-service leave, which might more familiarly be called a sabbatical. Every 6 years, employees are given 3 months off at full pay, or 6 weeks at double pay, to do whatever they like to do. Although they may do community work during that time, we encourage them to just rest and relax and do something that is fun for them.

Another common program is an employee assistance program. The employee assistance program is a program paid for by the company which encourages employees to seek psychological, emotional, legal, or financial counseling should they need it for themselves or their family.

Earlier, there was a lot of talk about people being unprepared to do jobs that are being brought about by new technology. I certainly agree with that. We also have programs for educational assistance which encourage people to go back to school to upgrade their skills so that they are eligible for new jobs that come up. There are also in-house training programs which might include on-the-job training, job rotation, monitoring, and various other types of programs, as well as in the classroom kinds of training.

One of the unique things—unique to Rolm perhaps more so than in any other industry—is a gymnasium which certainly addresses the physical health of its employees. That gymnasium allows an employee to undertake just about any kind of physical activity that they might choose, such as tennis, racquetball, basketball, volleyball, swimming, running, whatever.

Some other tangible programs which encourage employees to feel a part of their company are programs such as profit sharing. The more productive that the employees are, the larger the profit sharing.

The second area of stress reducers that I wanted to address is attitudinal or management style. I don't have time to go into some of the studies that have been done on the different types of management styles here in the United States or elsewhere. But some of the things that are alive and well in the high-technology industries are programs such as an open-door policy which encourages employees to talk about their concerns, their problems, their ideas, their opinions, their attitudes, what is working well and what isn't working well. It certainly is a stress reducer when a person has an avenue to vent their feelings or their ideas.

Another is that decisionmaking is encouraged at every level. I mentioned earlier that sometimes that is a stress inducer, but it is also a stress reducer in that people often like to make decisions that concern their lives. Also we have a program of participative management. One of the ways we demonstrate that is through quality circles, which is an opportunity not only for the employees to solve their own problems, but to define what those problems are.

Interestingly enough, the concept of quality circles was initiated in Japan by an American who had this idea many years ago and felt that American industry was not ready to listen, so he took his idea to Japan, and now we are relearning it from the Japanese.

We have a policy—a philosophy would be more correct—which encourages the building of a self-image, a good self-image. We do that through encouraging people to seek the skills that they need to take on new opportunities by giving people feedback about how well they are doing, where they could improve and how we support them in improving that lack of skill. We have many training programs to improve the quality of supervision, which leads to stress reduction. We have employee relations and organizational development programs to help management manage in areas where they may not yet have the skills or the knowledge.

I also wanted to address the social needs that are met in the work environment. Social needs get met in many informal ways by allowing employees to have maximum flexibility in their workday. There is often an opportunity to share ideas in a real informal way at any time of the day that it seems appropriate. We also have more formal programs, such as company picnics, ice cream socials, beer busts, dances, and those sorts of things, where employees are encouraged to get to know one another in a little more personal way, which encourages people to work together better as a team.

In conclusion, regarding the quality of worklife in high technology, there certainly are some stress inducers, but my conclusion is certainly that the benefits of an exciting, stimulating, creative work environment far outweigh the debits of the fast pace and the competitiveness.

Thank you.

Mr. WALGREN. Thank you very much.

Let's turn to Dr. Cole.

[The biographical sketch of Dr. Cole follows:]

4/20/83

Robert E. Cole
Biographical Sketch

Professor Cole holds a master's degree in Industrial and Labor Relations from the University of Illinois and a Ph.D. in Sociology from the same institution. He began his work in Japan in 1963, when he was awarded a two-year Ford Foundation grant. As part of his dissertation research, he worked as a semi-skilled worker in a die cast plant making auto parts and on the clutch assembly line of a large auto parts plant. This research resulted in his first book, Japanese Blue Collar. Since that time, he has actively conducted research on work organizations in Japan. Beginning in the early 1970s, he has been focusing attention on Japanese participatory work structures, particularly those known as Quality Control Circles. Most recently, he has broadened his interest to focus more heavily on the whole issue of Japanese management and quality. He has worked extensively with U.S. companies and unions in recent years, exploring what we can learn from the Japanese in these areas. His most recent book is Work, Mobility and Participation: A Comparative Study of U.S. and Japanese Industry, published by the University of California Press, 1979. After six years' service as Director of the Center for Japanese Studies at the University of Michigan, he is now serving as U.S. Project Director for the Joint U.S.-Japan Automotive Study. Professor Cole is a member of the Board of Directors of the International Association of Quality Circles and the American Productivity Center.

Dr. **Cole**. Thank you.

My name is Robert Cole, and I am a professor of sociology at the University of Michigan, and U.S. project director for the joint United States-Japan automotive study.

I have been asked to discuss the impact of new technologies on the quality of the workplace. I am going to leave the subject of displacement and retraining of those displaced to others. Rather, I want to focus on the impact of these technologies on those already employed or those who will be employed. I think it is worthwhile keeping in mind that while the unemployment threat and retraining needs are real and, to a significant extent, already with us, we shouldn't forget that the bulk of the labor force is employed and will continue to be employed and, therefore, we need to be concerned about their work conditions.

I want to begin with recounting an experience I had a couple of years ago when I visited Japan. Let me just say that I will draw upon my Japan expertise as a benchmark for evaluation, having done research in the Japanese work organizations since 1965.

I had the occasion a couple of years ago to visit with the staff of a major research insititute in Japan. They had just completed a large study on behalf of a variety of Japanese auto and auto part firms. The question they had been asked to address in this study was whether the Japanese auto industry had any reason to fear the resurgence of the American auto industry in view of the strenuous efforts that the Americans were making to catch up to the Japanese. Their conclusion was no. The chief researcher, in explaining those observations to me, said something like this: "The Americans are putting 70 percent of their eggs in the technology basket"—by which he meant equipment investment—"in order to generate needed productivity gains. But to generate the kinds of productivity gains that are possible, we think only 30 percent ought to be in technology, with the remaining 70 percent being divided between design and layout—10 percent—and nature of the manufacturing system in a broad sense—60 percent." I would add that improving the nature of the manufacturing system in a broad sense for the Japanese involves careful attention to the interface of technology with the human element.

One can argue with the conclusions of this particular research study about the probable success of the American auto companies, or whether they were really putting 70 percent of their eggs in the technology basket, but I think the chief researcher did highlight the central feature of the Japanese approach, that of building highly productive business firms with a cooperative labor force that is actively challenged to develop its work skills.

I spend a fair amount of time in my own work meeting with American businessmen, either going with them to Japan or talking with them after they have been back from Japan, and a fairly typical response one gets from these businessmen is that they were surprised to learn after they got to Japan that they were not significantly behind—and this goes for a range of industries—they were not significantly behind in hard technologies as they have been led to believe. But, at they same time, they were just as impressed that they were behind in the nuts and bolts of the manufacturing skills, or the implementation. You hear this often in robotics, specifically the view that the Japanese aren't ahead of us in the technology or robotics per se, they don't have better robots, it is just that they have implemented and diffused that technology in a very rapid fashion.

The point I would like to make here is that many of those manufacturing skills are social inventions. If you follow the current literature in manufacturing, one of the much discussed phenomenon of late is the so-called kanban system, or just-in-time delivery system. That is a social invention. It is not hard technology per se. For those who are not familiar with it, it is a system in which one produces and delivers finished goods just-in-time to be sold, subassemblies are completed just-in-time to be assembled into finished goods, parts are fabricated just-in-time to go into subassemblies, and purchases of materials arrive just-in-time to be transformed into fabricated parts.

Before going further, I want to make clear that I am using just in time as an example only—I am not saying this is a solution particularly—but it is an example, in effect, of a social invention that plays a very important role. Let me just pursue that a little bit.

In a narrow sense, just-in-time is an inventory control system, but in practice, it is far more than that. If one compares the typical inventory control system of a large American manufacturing firm with the typical just-in-time operation, one is struck by the high reliance on computers and the sophistication of the American system compared to the remarkable simplicity of the Japanese approach. Yet, the fact of the matter is that the history of technologically elegant scheduling systems in the United States is that they don't last very long.

Mr. Zenzaburo Katayama of Toyota Motor Corp. noted recently that, "If we were to utilize computers in order to take care of the fine tuning of the production schedules in lieu of kanban, we would probably need a capacity 20 times the present computers we have. Even with that, it wouldn't do all the jobs that kanban is currently doing. Among other things, it allows for rapid changeover of product lines, reduced plant size, and allows for quick shedding of defective parts.

Second, in developing this social invention, the Japanese were led in specific directions in pursuing further technological change, such as the evolution of rapid die changes for reducing setup times. My point in going on at some length here is that we ought to be worrying just as much, if not more, about our lag in the development of social technologies—and I would include in there, modes of diffusion as well—as against worrying about hard technology per se. I think a lot of the popular discussion is dominated by images of robotics which really are quite misplaced in many ways. That suggests that the nature of our technology investment is often misplaced. To put the matter differently, technology must be conceived of in the broadest possible sense. Yet, managers, and engineers in particular, commonly tend to focus on hard technology. I think, therefore, their contributions are limited.

One could provide a number of other examples, incidentally. Someone mentioned CAD, computer-aided design, in the earlier panel, which, in itself, for example, does not solve problems of how design interacts and cooperates with manufacturing people, which has been a major problem. Quality circles, incidentally, is also a social invention. Contrary to popular wisdom, there was no American advocating quality circles to the Japanese; that was a Japanese social invention. Dr. Deming was advocating statistical quality control, which is a totally different matter.

One of the central features of Japanese social technology is the way they manage the technology-human interface. They manage it in ways that generally have led—and I emphasize the word generally—to a multiskilled labor force, to decentralized decisionmaking and career development, rather than deskilling. That is being combined with flexible manufacturing systems, especially in consumer goods industries that are aimed at better serving rapidly changing consumer tastes. Meeting consumer preferences is a driving force, with flexibility being seen as a top priority manufacturing objective, not in the technical sense per se, but in a strategic sense.

When I make this latter distinction, what I am suggesting is that, in Japan, flexible manufacturing systems tend to excite not only engineers, but top management. That is a different way of putting it. Incidentally, the focus is on flexible manufacturing system, not on robotics per se, which is seen as a small piece of a systemic approach.

To draw the full advantages of this flexibility requires a committed labor force with broad-ranging occupational skills. It assumes a strong company commitment to continuous training. It requires a delegation to the employees of responsibility and control of the work process. That includes employee participation in the design of their own jobs. It also involves worker and union participation in the introduction of new technology. In short, it assumes participatory work structures.

I don't want to suggest, incidentally, that there is no deskilling that goes on in Japan, that hierarchical control is absent. Incidentally, permanent employment is far less pervasive than seems to be suggested by some of the discussions this morning. So, there are lots of problems with the Japanese system, it is quite coercive in some ways, but neverthess they have made great strides in developing a multiskilled labor force in a more participatory mode than what we are accustomed to. I think that is very important. They are not hung up on a technological determinism that assumes the deskilling of the labor force that seems to dominate a lot of our discussions or our assumptions. As Donn Parker of SRI put it so aptly recently, "Machines don't deskill. Management attitudes or motivations deskill."

The final point I want to make is simply that the challenge is to build workplaces where workers are challenged in their work, where they participate in its design, and where they are allowed to grow through the course of their work career. Not only is that compatible with the new technologies, but we will not realize the full fruits of those technologies unless we see that that happens. The point is that we are not talking about management altruism, we are talking about a self-interest in marrying technology and the human element to build more productive workplaces. If we don't do it, I can assure you that some of our competitors will do it better.

Thank you.

[The prepared statement of Dr. Cole follows:]

Statement of
Dr. Robert E. Cole
before the
Subcommittee on Science, Research and Technology
of the Committee on Science and Technology
and the
Task Force on Education and Employment
of the Committee on the Budget

U.S. House of Representatives
June 14, 1983

Impact of New Technologies on Quality of the Workplace

I have been asked to discuss the impact of new technologies on the quality of the workplace. I shall leave the subject of displacement to others more qualified to assess it. Rather, I will focus on the impact of these technologies on those employed. Furthermore, I will use my Japan expertise as a benchmark for evaluation.

Let me begin with this experience. Last year when I visited Japan, I had occasion to visit with the staff at a major research institute. They had just completed a large study on behalf of a variety of Japanese auto and auto parts firms. The question that they had been asked to address was whether the Japanese auto industry had any reason to fear the resurgence of the American auto industry in view of the strenuous efforts the Americans were making to catch up to the Japanese. In explaining their conclusions, a researcher said to me, "The Americans are putting 70 percent of their eggs in the technology basket (by which he meant equipment investment) in order to generate needed productivity gains. But to generate the kinds of productivity gains that are possible, we think only 30 percent ought to be in technology, with the remaining 70 percent being divided between design and layout (10 percent) and nature of the manufacturing system in a broad sense (60 percent)." And part of improving the nature of the manufacturing system in a broad sense for the Japanese involves careful attention to the interface of technology with the human element.

Now one can argue with his conclusions about the probable success of the American auto companies, but he does highlight a central feature of the Japanese approach: that of building highly productive business firms with a cooperative labor force that is actively challenged to develop its work skills.

Many American businessmen, upon returning from Japan, report that they were surprised to learn that they were not significantly behind in hard technology, as they had been led to believe. But they were just as impressed that they are behind on the nuts and bolts manufacturing skills. Now many of these skills are social inventions, such as the kanban or just-in-time delivery system, as it is often called. Just-in-time is a system in which one produces and delivers finished goods just in time to be sold, subassemblies are completed just in time to be assembled into finished goods, parts are fabricated just in time to go into subassemblies, and purchases of materials arrive just in time to be transformed into fabricated parts. Before going further, I want to make clear that I am using the just-in-time system as an example and not advocating it as a solution for everyone's problems. It is, in fact, not suitable for many industries.

In a narrow sense, just-in-time is an inventory control system, but in practice it is far more than that. If one compares the typical inventory control system of a large American manufacturing firm with the typical just-in-time operation, one is struck by the high reliance on computers and the sophistication of the American system compared to the remarkable simplicity of the Japanese approach. Yet, the history of technologically elegant scheduling systems in the U.S. is that they do not last very long.

Mr. Zenzaburo Katayama of Toyota Motor Corporation noted recently that "if we were to utilize computers in order to take care of the fine tuning of the production schedules in lieu of kanban, we would probably need a capacity twenty times the present computers we have. However, even with such a computer, it could not do all the jobs that kanban is doing." Among other things, it allows for very rapid changeover of product lines, reduced plant size, and allows for quick shedding of defective parts. Furthermore, in developing this social invention, they were led in specific directions in pursuing further technological change, such as the evolution of rapid die changes for reducing set-up times. My point here is that we ought to be worrying more about our lag in the development of social technologies than hard technology. This suggests that the nature of our technology investment is often misplaced. To put the matter differently, technology must be conceived in the broadest possible sense. Yet, managers, and engineers in particular, commonly tend to focus on hard technology. Thus their contribution is limited.

One of the central features of Japanese social technology is the way they manage the technology-human interface. They manage it in ways that have generally led to a multi-skilled labor force and career development rather than de-skilling. This is being combined with flexible manufacturing systems, especially in consumer goods industries that better serve rapidly changing consumer tastes. Meeting consumer preferences is the driving force, with flexibility being seen as a top priority manufacturing objective, not in the technical sense per se, but in a strategic sense. To draw the full advantages of this flexibility requires a committed labor force with broad-ranging occupational skills. It assumes a strong company commitment to continuous training. It requires a delegation to the employees of responsibility and control of the work process. This includes employee participation in the design of their own jobs. It also involves worker and union participation in the introduction of new technology. In short, it assumes participatory work structures.

This is not to suggest that there is no de-skilling taking place in Japanese firms, nor that hierarchical control is absent. Indeed, some aspects of the traditional Japanese management system are quite coercive in ways that I would not suggest we emulate. But clearly, they have made great strides in developing a multi-skilled labor force in a more participatory mode than we are accustomed to. And everything suggests that they will continue down this road as they adopt the technologies of the future.

What is striking about this description relatively speaking is how backward many American management and scholarly ideas on this subject are. Technology too often is seen as an autonomous force working its will on work organization in an unthinking fashion. We debate whether de-skilling is inevitable, often citing examples where it occurred in the past. All too often we assume a kind of technological determinism as opposed to recognizing that technology commonly limits and shapes our options but does not predetermine specific outcomes. As Donn Parker of SRI put it so aptly recently, "Machines don't de-skill. Management attitudes or motivations de-skill."

So the challenge before us is to build workplaces where workers are challenged in their work, participate in its design, and are allowed to grow through the course of their work career. Not only is this compatible with the new technologies, but we will not realize the full fruits of these technologies unless we see that this happens. Moreover, if other national economies realize a better fusion of technology and the human element, we will not only have less satisfying workplaces in the United States, but we will also fall farther behind in the competitive struggle.

Mr. MacKay [presiding]. Thank you, Dr. Cole.
Dr. Stellman.
[The biographical sketch of Dr. Stellman follows:]

BIOGRAPHICAL SKETCH

My name is Jeanne M. Stellman. I am an Associate Professor of Public Health in the Division of Health Administration, School of Public Health, Columbia University. I am also Assistant Director for Cancer Control of the Columbia University Comprehensive Cancer Center. I founded and am Executive Director of the Women's Occupational Health Resource Center at Columbia and also fulfill a number of other appointed positions within the University. I hold a number of extra-mural professional positions including being an elected member of the Governing Council of the American Public Health Association, Chairing the Advisory Committee on Reproductive Hazards in the Workplace for the March of Dimes and serving on the Governor's Technical Advisory Committee for the New York State Right-to-Know Law. In the past I have served in many consultative positions to the government, including being a member of the Secretary of Labor's Advisory Committee on 14 Carcinogens and the Surgeon General's Taskforce on Health in the 1980's. I am currently serving on the Advisory Committee to ADAMHA for its international conference on Work for the forthcoming year.

I am the author of three widely used texts on occupational health and numerous technical papers, chapters and other articles. I am one of nine national recipients of a Preventive Oncology Academic Award from the National Cancer Institute and have been awarded several peer reviewed research grants from the National Institutes of Health, the Environmental Protection Agency, the Ford Foundation and other agencies. The Women's Occupational Health Resource Center is supported by the New Directions Program of the Occupational Safety and Health Administration.

Dr. **Stellman**. Thank you for the opportunity of speaking here. I don't have my written testimony with me. It actually got stuck in my word processor, and I will be sending it in.

By way of introduction, I am an associate professor of Public Health at Columbia University, and I am the executive director of the Women's Occupational Resource Center which has received extensive support from the OSHA new directions program. I am assistant director of the Comprehensive Cancer Center for our cancer control program, and I am the principal investigator of an NIMH grant for the Center for Work and Mental Health on office worker well-being.

I believe that the topic that we are addressing is probably the most significant employment question that faces us; the impact of technology on working life. Much of the recent focus on this question in the labor movement and the technical and popular literature has been on video display terminals and their impact on white-collar workers. This is understandable. The Bureau of Labor Statistics estimates that by 1990 23 million out of the 120 million workers in the United States will be office workers handling paperwork either generated by machines or used on machines. The mechanization of office work is thus a timely and important topic.

I would like to make what may appear to be an ironic statement: Mechanization does not begin and end with the white-collar worker. Our lifestyles, the ways we live and work, are the result of mechanization. A good perspective to have is that less than 100 years ago, 70 percent of all Americans were employed in agriculture. In 1983, less than 3 percent of our population feeds the entire population and, indeed, grows enough food to export. In the course of 100 years, we have been transformed from a largely rural society to a virtually total urban society. With the advent of the microchip America and the rest of the industrial world is replicating the revolution in white-collar work in less then a decade.

The potential psychological, economic, and social impact of this rapid change is enormous: 23 million clerical workers by the end of the decade; 22 million people in engineering, drafting and other similar technologies; 2 million laboratory technicians—I am a chemist by training, and unlike the old days of chemistry—less than a generation ago—where you diddled and daddled with liquids, today everything is controlled by machine—1 million accountants; 1 million telecommunication workers; and several million others. Each of these occupations is tied to microtechnology. Mechanized work will involve more than 50 percent of all American workers. This stage of industrialization is clearly the equivalent transformation to the conversion to an urbanized society taking place in a fraction of the time.

But does mechanization really represent a transformation? Is the nature of working life really being transformed? If so, is it bad? I think these are critical questions to be answered. There is clearly no simple answer. The analysis of the industrial revolution will show us that for every good, there will be an evil; for every evil, there will be a good. So that coming out as an advocate or in opposition to advancing industrialization is very shortsighted. Let us consider the implications.

Automation of the office can be seen as the ultimate in "Taylorism," or taking a product and manufacturing it by breaking it down into its component parts. This goes hand-in-hand with analyzing the worker and breaking down his or her tasks into component parts—a process often called deskilling. We reserve our artisans and craftsmen now for exhibits on street fairs and in local fairs. The person who produces a whole piece of work is really a historical relic that we take our children to see on a Saturday afternoon.

I think it is important to know some of the social costs. Dr. Cole began to allude to them. Academics like to speak of control of the workplace, particularly in a job which is highly demanding. There is mounting research evidence demonstrating that the absence of control over one's work is co-related to stress-related diseases, such as cardiovascular diseases, and to secondary diseases with which we must deal as a society such as job dissatisfaction, absenteeism, and substance abuse. Each of these problems are related to the ways in which we work and live.

It is important to realize that the introduction of microtechnology based work processes for the automation of white-collar work is based on the industrial model. It uses an analysis of the flow of work, which breaks the flow into tasks, and then transforms the tasks into ones that are controlled by the software—computer programs. This process is the antithesis of the kanban that Dr. Cole just spoke of. It is taking the secretary or other office worker, or task like a banking operation, breaking the work down and removing discretion from the people who carry out the task, so that, just as I couldn't get my testimony out of the computer because my two terminals refused to talk to one another, so, too, the employee who works in an automated system is unable to make changes in the software. Indeed, the computer programmer who works on the overall system generally works on only one aspect of it and has little overall control.

In our current research work on office work, we find that the greatest stressors are the meaningless of work, the inability to have a sense of completion or accomplishment about your task, the repetitiveness and the loss of skills, as well as an inability to understand what is demanded of you by the job. We heard statements today that people are not being trained properly. It is true that we are not training people properly, but simply teaching them what buttons to push does not mean that we give them new skills. We are teaching them new techniques, just as the new weld on the assembly line on the car is a new technique, but to call this is a skill is to glorify the task.

This deskilling of work has health implications, stress-related health implications. I am not going to discuss those because of the very short amount of time. But there are also physical health implications, ergonomics. And there are clear research needs; there is not a single study in the literature today on the effect of having to accommodate one's eyes to the same viewing distance all day long as occurs with VDT work. There is an immediate need for research on the effect on VDT's on eyes. Our work at Columbia and recent work from the University of Wisconsin has shown that video display terminal operators do suffer more eyestrain than clerical workers doing a similar job. Whether this strain is the function of the stress, of the poor lighting, or of the visual demands, is still not known, and there virtually are no research dollars being put into this at all. Our group is documenting hand, wrist, finger cramps and other problems from the person-machine fit and the same questions of causation still persist and need research and explanation.

Offices are not designed for computers and terminals. Most terminals are simply placed into an office, helter-skelter, without any regard to the lighting. In fact, to use the word design for most offices is a total misnomer. Indoor air pollution is a good example of that.

These are technical problems. I feel there are technical solutions. I don't believe that radiation is an overwhelming problem from these machines, but it is enough of a problem from a small enough number of these machines that we need immediate regulation through the Bureau of Radiological Health or other agencies that will require the manufacturer to test the machines and to allow the consumer and the user and the office manager to know what levels, if any, are being limited from a particular model. That kind of testing is almost impossible to do on an individual basis so that it must be regulated just as the Government regulates other potential radiation sources.

Money is needed for research, training, and education, not necessarily on which skills to train people in but to understand the implications of the person-machine interaction. The two major kinds of work in our society are machine interactive and people-interactive jobs. We know these jobs are both stressful, but we don't know enough about why and how and what to do about it. We need to marry the physical and the social sciences to deal with this problem and government funding and research policy can effect that interchange.

It is, in a way, very different than some of the other health and safety problems we have faced in the past, where, for example, the coke ovens with their noxious fumes were 100 years old and producing cancer. In many ways, the modern, automated employer can't keep a 100-year-old VDT because it will rapidly become obsolete and there will be no other computer to talk to. So there is a continual recapitalization in modern microtechnology. But there is the necessity to understand that capitalization of the computer itself does not necessarily include human conditions. The setup in the executive front office is very different from the backroom setting. And the very lovely conditions that we heard Ms. Wicks talk about are not typical of the data entry clerk who is now working on rotating shifts in the basements of Wall Street, working 7 hours a day of continual data entry.

Employment in microtechnology industries brings the need for a new kind of regulation and a new kind of governmental examination of how and why people work. Our society long ago agreed that working people should have an 8-hour day. Now we have to ask ourselves other questions that relate to automation: does an employer have the right to keep a lifetime record on a microchip of how many key strokes per second a worker has produced and what their error rate is; what is the potential for electronic eavesdropping on employees by employers; and what controls are needed.

This has not been considered anywhere. We have looked at the civil liberties of us as citizens, but we have not looked at the civil liberties of the working population.

It is possible to sign on with the Federal Government in your first year of employment and, by the end of 30 years, have the Federal Government know in one little chip exactly what you have produced every day of your working life. I think this is a whole new area of labor-management relations that needs exploration. The degree of control that we can exercise as employers over employees now is really phenomenal to any other time in our history.

The question of worker displacement is very important. I find the only way to keep up is by reading the trade magazines. I picked up two ads just on the way in this morning on displacement, about the question of what happens to the $65,000-range employee who doesn't know how to use a computer and his inability to find new work.

There are profound implications for social well-being. These changes that have happened so fast need close examination that includes the costs of displacing people and teaching them new skills within 6 months, within 12 months. One need not be a social scientist to know that such change will produce a tremendous amount of strain and social displacement of working people and this strain is not cost free.

The final aspect that I would like to end with is to turn around the Toffleresque electronic cottage image where we are all going to be working in our homes and benefiting from the convenience. What we really are talking about is the reinstitution of cottage industries as work is fragmented and put out through computer telephone lines to people, who will largely be women with dependent children, working in their homes. I came from a working-class family. In our neighbored women used to sit and type envelopes to make extra money alone, at substandard wages in their kitchen, with no benefits and strict productivity requirements. That is exactly where I believe we are going in the 1990's. It is not the glorified electronic cottage signifying freedom and stature, but the undercutting of minimum wage, the reintroduction of piecework, and the control of work at home from centralized areas which will further increase the powerlessness and alienation of our society.

I think the final word that I would like to say is that we, with modern technology, have conquered many things—notably childhood disease, childhood mortality—but we have not done much for the middle-aged person. The middle-aged person in 1983 has virtually the same life expectancy as he did in 1900. He can, by and large, expect to die of chronic disease, to be divorced, to have his or her children move away, to be a substance abuser, and to be glued to a TV set behind a triple-locked door. The growing alienation and powerlessness in the workplace, I think, in a large way, we can be related to factors in the workplace which are reflective of our social society as a whole.

Thank you.

Mr. GEPHARDT [presiding]. Thank you for your statement, and all of you for your statements.

We will begin the questioning with Representative MacKay.

Mr. MACKAY. Thank you, Mr. Chairman.

It seems to me that Dr. Stellman and Dr. Cole are pointing to the fact that, in this country as contrasted to Japan, we are moving into high technology in a way that is almost, I guess you could say, very counterproductive. We may end up getting the same result in terms of productivity per machine hour or per operator hour; but in terms of the quality of life in America, we are going in a very unhealthy way.

Am I picking up that as sort of the general theme?

Dr. Cole. The only point I would make is I don't think we will get the same productivity. The argument that I have made is that, by a more effective marrying of the human element with the technology, the Japanese will get more out of it.

This is a very simple example, but we have a lot of jobs that we call routine, whether it be monitoring some sort of dials or whatever. One of the key things with a lot of that technology is what happens in a crisis. What happens when, in a rare situation, something occurs out of the routine? ARe people trained to respond to that? Do they have the discretion—to go back to an earlier term—to respond to that?

I think, in that sense, what the Japanese are saying is nothing is entirely routine, that there is room for individual initiative, and one ought to be trained to use that initiative. And they work harder at that. Not that they have solved all of the problems, by the way.

Mr. MacKay. Is this a problem that Government should deal with, or is this a problem that has come about because of labor-management—more of an adversary system in this country and less of a participatory tradition?

Dr. Stellman. I would like to add to his answer. Not only do I think we are not going to be more productive, but I think the only reason that it appears we are more productive is that a true bottom-line analysis of the true impact of diminishing quality of life on health and other aspects of the social system, the costs of workplace alienation and worker stress, are not tallied. That is the overall problem of occupational health, that occupational disease is an unpaid social cost, passed along to all of the other social systems, including social security, the Veterans' Administration and other pension plans.

I would like to emphasize, as Dr. Cole did, that to make simple comparisons between the Japanese and the American system as such is not appropriate, because we are not Japanese and they are not American, and most Americans could not function very happily in Japan. Our cultures are drastically different.

Mr. MacKay. But all workers everywhere would like to have a meaningful job and would like to participate in the decisions that lead to the way their life is——

Dr. Stellman. I think it is a question of true participation, which is very important. That is what worker participation is about: to have some real input into the dimensions of what you are required to do, to have an understanding of why you are doing it; not just simply talking about participation in a circle, but at the end of the discussion finding an exit from your quality of life circle so that what you have done inside your circle actually makes its way out. To have workers simply talking to one another, you might as well go out and do some exercise, which would at least be good for their cardiovascular systems. They have to see where their discussions and their input will actually have an impact.

The Swedes have done some wonderful work on the relationship between alienation on the job and the fact that people don't vote, don't participate in their unions, don't do the things that we need as a society, in their lives as citizens. They posit that stress on the job and a of lack of control lead to such alienation.

Mr. MacKay. This may not be a rational point to ask this question, but I would like to know from Ms. Wicks, is your company a unionized company?

Ms. Wicks. No, it is not.

Mr. MacKay. Do you think that you could have the kinds of programs you have in an adversary bargaining situation? I am just curious as to whether or not our industrial model of labor-management relationship is now something that is an anachronism?

Dr. Stellman. But bargaining is not always an adversary process. That is what the newspapers say. I used to be assistant to the president of the oil, Chemical & Atomic Workers——

Mr. MacKay. Let me say maybe that is what the newspapers say, but just this once, I would like to say I have never seen a bargaining session that was not.

Dr. Stellman. Have you ever been, Congressman, in a bargaining session?

Mr. MacKay. I suggest I may have been in more than you have. Yes, ma'am. I have lived in another world for some 40 or 50 years.

Dr. Stellman. There are many positive things that come out of bargaining sessions, such as pension plans and other benefits that have been extended to other workers in nonunion companies.

Ms. Wicks. May I make a comment?

At the risk of greatly insulting someone here, I can't imagine—

Mr. MacKay. Have at it.

Ms. Wicks. I can't imagine that we could have the working conditions that we have if we had a union in our company. I think it would be an obstacle to good relationships between management and nonmanagement. I can't even use the "worker." It sounds so archaic to me. It is simply that some people are managers and that some are not. And the relationship, whether it be through informal channels of just casually walking through the factory and stopping and talking to someone, or through a quality circle—or a thing that we call a rap session which is getting people together and saying: "What do you think about this. You say we really have a great place to work. Do we really? Do you feel that?" I can't imagine that with a union present.

Dr. Cole. I have two quick comments. One is in response to Cheryl. I think, in part, you may have such wonderful working conditions precisely because there are unions in our society. That is, a lot of nonunion companies have adopted these kinds of practices specifically with an eye to keep out unions. That is simply a fact. If you have ever gone to management seminars, you would be well aware of that.

The other point I want to make is, having done a lot of work in the auto industry in the last few years, I am rather impressed at the kinds of things that are being done today—for example, at Ford

Motor Co., in the area of participatory practices—that lead me to think that that is where the challenge is, as a matter of fact, and that some good things can come out of that. I am not altogether confident that it will all turn out OK, so to speak, but they are finding that there are areas where they can cooperate where they have mutual interests.

Interestingly enough, it tends to feed back into the bargaining process. Plants find, for example, their grievance loads go down when they are cooperating in these other areas. So even though they are kept separate, as a matter of policy, in fact, there is a feedback mechanism that tends to operate.

So I wouldn't simply rush to the conclusions that our labor-management system is obsolete. I think changes are underway. And I wouldn't underestimate the benefits of conflict either, though it is currently all the fad that we have to emphasize cooperation. Conflict, after all, does lead to some fruitful outcomes.

Dr. STELLMAN. I think that there is a range of labor and management as well, that what is very regressive in one sector can be very progressive in another. One area that is a very good example is to just go into several hospitals. Look at New York City and what happened to job turnover after hospitals became unionized. Now you have a steady employed and skilled work force where it used to be the most senior person would have, at most, 2 years on the job, and the implications for health care, both for the employees and the patients of such an unstable setting.

Mr. MACKAY. Are their disincentives—I apologize for going on so long with this—are there disincentives in our current laws to developing a new type bargaining, more cooperative—in other words, I am looking in each one of these panels for the question of what part of this is Government involved, and should we be involved with it?

Dr. COLE. I am not immediately aware of many disincentives imposed by legislation. We have heard a lot of suggestions about a possible Federal role. The one area we haven't heard about is the role of Federal employment in setting some kind of model.

I think there is an awful lot that can be done in the public sector in this area. I know of some starts being made in the Postal Service and in the IRS. But it seems to me there are also opportunities for the public employment to serve as a model for what can be done in the participatory area. The Department of Defense, by the way, is another place where there are a couple of interesting things going on. A lot could be done. And that could then spill over to the private sector in terms of strategies and models developed, and so on. Maybe that is a good way to think about the Federal role.

Mr. MACKAY. Thank you.

Mr. GEPHARDT. Congressman Mineta.

Mr. MINETA. Thank you very much, Mr. Chairman.

Cheryl, you have been with a firm that probably in its 13 years of existence now has grown probably at an average rate of maybe 30 to 35 percent per year. You are right, your former executive vice president said, "We don't have a personnel department, we have a department of GPTW." I said, "What is GPTW?" He said, "It's a great place to work."

Given the fact that you have grown that fast over a 13-year period and you have some very innovative practices there at the company, programs you described maintaining the quality of the work life are not necessarily those that should be limited to just the high-technology industries. Yet, in most instances, these kinds of programs have only come out of high-technology industries.

Why would you say that that is the case? Second, are there ways that you think what is done at a high-technology company such as yours can be transformed or used in some way in what might otherwise be described—and not in a demeaning way—but what is described as a smokestack industry?

Ms. WICKS. I think perhaps a lot of these programs have come out of high technology because, historically, a few people in high technology—perhaps two of them being Bill Hewlett and Dave Packard, the company I used to work for, and perhaps IBM and a couple of others—set a standard, and I think other companies emulate that. High tech is very competitive. I think that Dr. Cole mentioned—this isn't quite the term that you used, Dr. Cole—but sort of enlightened self-interest. It isn't only altruism, but it makes good business sense as well as good people sense to treat people correctly. I think also what you said, Dr. Cole, about perhaps we have a work environment like that as a result of unions. It is certainly true that we want to maintain a nonunion status. But I think it is more enlightened self-interest.

I guess I see the obstacle to other industries taking on that kind of a system or management style is that anytime changes are required, people resist. So if we were to begin—let's say the automobile industry today—someone who was beginning in the automobile industry looked around and said, "Gee, high technology does it this way, it really works; let's do it," that would be easy to front-end something. But when you are trying to undo history, it is just not easy, and people don't change quickly, and people tend to cling to what they know as opposed to going forward with what they don't know. And what if it doesn't work? What we have right now works OK. What if we try something new and it doesn't work? What if we have chaos. I mean, what if we let employees actually be participants, elevate expectations, and then we end up with chaos and have to go back to the old ways? So I think it is fear of change, and change does not happen quickly.

Dr. COLE. I would just add a comment on that. I spent some time at Hewlett Packard and a couple of the other high-tech companies. I think the major preconditions to these kinds of practices is rapid growth. Rapid growth means that you can invest in training and use those skills in a rapidly growing situation in terms of promotion patterns, in terms of giving people skills that they can use. It is not a guarantee, but it makes it a heck of a lot easier to pursue these kinds of management policies in a rapid growth situation.

The other point—and I think it is consistent with Cheryl's remarks—you are dealing with a legacy of management-labor relations, and in a sense—it has got nothing to do with high tech per se—but simply that you have a newer generation of managers who grew up in a different environment with different understandings of what was possible. They are simply not as weighted down by the past, if you will, than in many other traditional industries.

Mr. MINETA. Is that more symbolism or is that a real thing? In our area, I will go see Charlie Sporck who is the president of National Semiconductor, head of company with maybe with 30,000 employees, and he is in an open workspace. He does not have a private office of his own. He is among everyone else with just the divider panels, and he has got a cubicle of 7 feet by 12 feet maybe.

Dr. COLE. What is your point? Is that symbolism?

Mr. MINETA. Is that symbolism, or is that a management style that portrays anything different than the General Motors executive who has to have the status symbol of a mahogany, 30- by 27-foot office?

Dr. COLE. There is clearly a lot of symbolism in both approaches, if we are going to categorize. I remember talking to Hewlett-Packard and people and, just as Cheryl just did, "We don't have workers here." I find that bizarre, to tell you the truth. I think it is a self-deception. But it is part of the symbolism, part of the apparatus, that goes with that system, of egalitarianism, and so on. Similarly, in a traditional auto factory, there is a whole lot of symbolism involved in maintaining the adversary this relationships.

Dr. STELLMAN. It is an unfair comparison to compare the whole auto industry to the electronics industry. The electronics industry has, by and large, shipped away overseas its dirty work and its menial work of data entry and gluing down the semiconductors on the boards.

If we went to Detroit and simply looked at the executive offices and simply looked at the skilled workers and the design people and made a one-for-one comparison with the executive corps and designers in electronics, I am not so certain that the auto industry would come out any worse than the high technology industries. But when we talk about data entry clerks in the basement of Wall Street and the work that is shipped out to the Third World and to Ireland—Ireland is the largest place because that is, economically speaking, an English-speaking Third World country—when we look at labels shipped out to Iowa—when you go for new subscriptions to your magazine, it will go out to Iowa where people sit, day in and day out entering data, then the comparison to the assembly line in Detroit can easily be made. Soldering the semiconductors together is a very clean environment, not because of the workers' lungs, because the boards are going to be ruined if dust comes on them. But the effects of the solvents and the biomechanical stresses may be just as bad as some health effects in auto.

If we do that kind of comparison, I am afraid that high technology no longer looks so good. In fact, in many ways, it is worse than the automobile industry, where at least people have decent pension, decent welfare, some kind of control of working conditions through their Unions.

Symbolism only takes you so far. The man in the open office still retains the right to hire and fire, to close down large factories and displace large numbers of workers. That is the reality.

Ms. WICKS. I really have to disagree.

Mr. MINETA. Very quickly, on page 2, Dr. Cole, you mentioned in your statement about kanban or the just-in-time delivery system. The problem I see with your approach on this, frankly, is you can take Japan and put it all in the State of California. When you talk about Toyota, whether it is their engine plant or their assembly plants, they are all within a relatively short space there within Toyota City. Whereas, here you are shipping things from Detroit to the assembly plant in Milpitas, 2,500 miles; there you are doing it 30 miles. The size thing is just very greatly reduced. So I think that, yes, they can.

The other thing is that they are not afraid about a 30-day strike that might shut them down. Here, they have got to inventory parts just in case something might happen.

Dr. Cole. I made clear in my remarks that I was using kanban as an example. I wasn't advocating it. It was an example of a social invention. We have to have our own social inventions that fit our environment.

It so happens, incidentally, that partial versions of just-in-time are being instituted, for example, in the Midwest where the geographical distances are far less, and where there is occurring currently a reconcentration of the automobile industry. Why are all those plants in California being closed? There is a reason.

In any case, I wasn't advocating kanban; I am simply pointing out that it is a social invention, and we need to think more about social inventions in dealing with technology and not just the technology itself.

Ms. Wicks. May I make a comment about symbolism?

Tom Peters, who has written a book called "Excellence in Management," and has studied many different types of companies managed in many different ways and in many different industries, talks about the companies that he sees are well managed and profitable and what he would consider to be good companies. He talks about what is the magic of those companies. He says that people search endlessly for some magic, and the magic is that people in those companies communicate. Some of those companies are the HP's and the IBM's and mostly high tech, but not all high tech, like Procter & Gamble.

So if you go to the example of the person at National who is sitting on the floor as compared to somebody who is sitting up three floors, I think that anything a company can do physically to enhance communication—if you have to go three floors to talk to somebody, I guarantee you won't talk to them as much as if you can turn around and look over your shoulder and talk to them. So that is what I would say about the open space.

Although, I would also say that open space or an open door is a state of mind as opposed to literally an open door.

Mr. Gephardt. Thank you very much.

Would the members want to return to ask questions? What is your pleasure?

I think we will end the hearing at this point. We deeply appreciate your being here today and for making this testimony. Thank you very much.

Mr. Dymally. Mr. Chairman, I do have some questions for Ms. Wicks, and I may call the phone or write them.

Ms. Wicks. That would be fine.

[The information follows:]

Questions

Submitted by the Hon. Mervyn M. Dymally

1. How might a production worker at ROLM advance to more highly skilled work?

2. How rapidly has automation taken over blue-collar work at ROLM?

3. At one time, ROLM divided departments by ethnic groups. There was a department of Latino workers, a Vietnamese department, A Filipino department, etc. What is the present practice? What was the rationale for the division of labor I have described?

4. A high proportion of production workers are women, immigrants and ethnic minorities. What programs does ROLM have to aid their advancement? How many women, immigrants, annd ethnic minorities hold enginering or management level positions now at ROLM?

5. You mentioned that ROLM has a recreation center. I understand that it is some distance from the worksite of your production workers. What percentage of these workers use the recreation center?

ANSWERS

SUBMITTED BY CHERYL WICKS

1. Through additional experience and on-the-job training or through additional education. Should additional education be needed ROLM will reimburse employees for tuition and books.

2. Automation has not taken over blue-collar work at ROLM. We have laid no one off because of it, and in fact have continued to add people in Santa Clara, as well as adding sites in Colorado Springs and Austin, Texas. In some cases automation has enhanced jobs and made the work more meaningful. In turn we are more competitive world wide which allows us to add more jobs.

3. Although all ethnic groups are represented throughout the work force, ROLM has never divided its departments by ethnic groups.

4. As mentioned in #1 we have an educational assistance program. As well, a great deal of cross-training goes on on the job. We have a job posting system so that people can seek out promotional opportunities. We will also pay for English as a second language program if needed. Women and ethnic minorities are represented in Engineering and Management levels. Exact numbers are confidential data and only available to the OFCC.

5. The recreation center is actually in the same building as many of the production workers. Fifteen percent of all employees use the recreation center regularly (3 or more times per week). Sixty-four percent of all employees use it intermittently. We do not keep statistics of recreation center useage by job category. However, my visual observation is that production workers are well represented there and use it as much as anyone else.

Mr. **Gephardt**. We will resume the hearing tomorrow morning at 9:30 in this room.

Thank you.

[Whereupon, at 12:15 p.m., the subcommittee and the task force were adjourned.]

TECHNOLOGY AND EMPLOYMENT

WEDNESDAY, JUNE 15, 1983

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY, AND THE COMMITTEE ON THE BUDGET, TASK FORCE ON EDUCATION AND EMPLOYMENT,
Washington, D.C.

The subcommittee and task force met, pursuant to call, at 9:40 a.m., in room 2318, Rayburn House Office Building, Hon. Richard A. Gephardt (chairman of the Task Force on Education and Employment) presiding.

Present: Representatives Gephardt, Dymally, MacKay, Simon, Valentine, Sensenbrenner, and Skeen.

Mr. GEPHARDT. The hearing of the panel will begin. This is panel 6 on training and retraining. Our first three witnesses are Hannah Levin, Don Swain, and Gene Bottoms.

If they are here and if they would come forward, that would be appreciated. Dr. Levin on the far right and Dr. Swain in the middle with Dr. Bottoms on the left.

We are very happy to have you here today. We welcome you and thank you for being willing to come and give testimony on these important topics.

We have a 10-minute timer which we are trying to use to help us keep on schedule. When the light turns red, that means you should try to sum up if you can and then we will go to questions.

Our first witness will be Hannah Levin, Assistant Director, Office for State Colleges, New Jersey Department of Higher Education. Welcome.

[The biographical sketch of Dr. Levin follows:]

HANNAH ALEXANDER LEVIN

I received my Ph.D. in Social Psychology from Rutgers University in 1964 when I was already the mother of four children. The integration of the role of professional with the role of mother sensitized me early to the problems and the possibilities of careers for women.

I have taught, developed and administered programs that focused on how knowledge could be utilized in improving human well being. Aware that an individual's physical and mental health are influenced, and often determined by social, cultural and economic factors, I designed programs that were interdisciplinary in nature.

For five years I was responsible for the post-doctoral program in Community Mental Health at Albert Einstein College of Medicine (1967-1972). I also served as Chief Consultant in health to the Hunts Point Multi-service Corporation in the South Bronx. I wrote their program and proposal for one of the first community controlled health and mental health centers in the country which was funded for 5 million dollars.

In 1972 I was appointed Professor of Biology and Psychology and Coordinator of health related programs at Livingston College of Rutgers University. I developed the first Physicians' Assistant program in New Jersey in cooperation with Rutgers Medical School. Also while at Livingston College, I received almost half a million dollars from the Office of Health Manpower to direct a program to help disadvantaged students gain entry into the health professions.

While a professor of psychology at Richmond College of CUNY during the New York City budget crisis in 1975, a large number of my students who were police, firemen and school para-professionals were laid off. This stimulated me to study and teach the role that work plays in the life of the individual and the many complicated physiological and psychological effects of unemployment. I received a grant from the Wright Foundation to travel to Sweden in the summer of 1978 to familiarize myself with their research on factors in the workplace that cause stress and illness. I also looked into the Swedish intervention programs developed to ameliorate these conditions.

I was able to apply some of what I learned in Sweden when I was chosen to be a National Science Foundation Public Service Resident and be the educational coordinator for the International Union of Electrical Workers, District Three.

In addition to these experiences, from 1972-77 I served as a member of a National Institute of Mental Health review committee which funded innovative interdisciplinary programs in mental health. I also chaired the Board of

Social and Ethical Responsibility of the American Psychological Association for two years. I have been an Associate Editor of Transaction/Society and on the editorial board of the Journal of Health Politics, Policy and Law since its inception.

I have been a Lecturer at Rutgers Law School and a consultant to its Constitutional Litigation Clinic since 1972. As a consequence of my teaching a course called Social Science in the Courts, I became interested in examining and evaluating judicial practice in the utilization of social science theory and data. I was particularly interested in cases where social science was used to establish legal policy. I became a co-investigator with Professor Frank Askin of a study funded by the National Science Foundation on the U.S. Supreme Court's use of social science in its decisions between 1965 and 1974.

I have found the public policy litigation area to be a challenging frontier for social psychological teaching and research. I believe a rational system of justice requires scientific input. And psychologists can make an important contribution to lawyers involved in litigation in areas such as privacy, police surveillance, newsmen's privilege, affirmative action and deinstitutionalization.

At present I am an Assistant Director for Academic Affairs in the Office for State Colleges, New Jersey Department of Higher Education. I have responsibility for academic programs at four of the State's Liberal Arts Colleges. I work directly with the Vice Presidents of Academic Affairs at these schools helping them to plan and implement Board of Higher Education policy. In addition, I assist in the development of new programs and strategies for meeting problems relating to retention and recruitment of students.

A great deal of my career has been spent developing innovative programs of academic excellence that were at the same time responsive to societal needs. I have found that the best learning environment is one that is cooperative, and promotes disciplined, independent inquiry. Students and faculty alike must feel free to question and carry in new directions the body of formal learning on which modern society stands. This critical search cuts across traditional discipline boundaries connecting art, science and the humanities. I believe we need vision in the world of facts and feelings that can nourish thinking.

I have found being an educator a most rewarding career. Although the television and the newspapers conspire daily to make me gloomy, my students and colleagues renew my optimism as they enthusiastically pursue the urgency to learn, to grow, to create.

STATEMENTS OF DR. HANNAH A. LEVIN, ASSISTANT DIRECTOR, OFFICE FOR STATE COLLEGES, NEW JERSEY DEPARTMENT OF EDUCATION; DR. DONALD C. SWAIN, PRESIDENT, UNIVERSITY OF LOUISVILLE; AND DR. JAMES E. BOTTOMS, EXECUTIVE DIRECTOR, AMERICAN VOCATIONAL ASSOCIATION

Dr. LEVIN. The nature of work is changing at an accelerating tempo and as factories and offices introduce successive waves of new technology, the structure of the American workplace is being fundamentally reshaped.

The choices made relating to the education of those presently in the work force will be crucial as the nation shapes its economic and social future.

I believe an overriding consideration as we introduce automated machines is that we must preserve and enhance human autonomy.

Those who make social policy decisions must confront the challenge of automation with new educational initiatives, initiatives that preserve and imaginatively expand the role of the human actor at work. It would be socially destructive if just as we move into the liberating potential of the "Information Age," untapped resources were ignored and neglected and the American workplace became less challenging.

One hundred years ago, the Industrial Revolution also obliterated existing labor patterns. Then the Nation's public school system played a vital role in preparing a burgeoning work force for a mass production economy. As our agrarian society industrialized, basic literacy was an imperative.

Today the Nation again faces awesome education obligations. A major debate has already begun on how to best strengthen science and math teaching. In many public schools, there is a drive for computer literacy that begins in the early grades and continues through college.

There is a crucial area of education, however, that is not getting adequate attention or support: retraining of employed adult men and women who may soon face job loss or downgrading because of technological advances. Seventy-five percent of those working today will still be in the work force in the year 2000. They must be prepared for the change.

It is estimated that in the past decade, close to 40 million workers have had to change jobs or endure unemployment because of our changing and turbulent economy. As a result, there is a new awareness in the work force that employability is ever more dependent on access to educational programs that deal with the new technology.

We do not need narrow, short-term, quick-fix programs that are revolving doors to repeated displacement and deskilling. We must have, instead, a well-planned program that provides workers with new, high-tech job skills, the requisite educational foundations to insure flexibility and an understanding of the impact of technological change on work. All this so that our future work force will be more able to adapt and participate fully in the new technological world.

The obligation falls increasingly on the institutions of higher education, particularly the community and State colleges. These institutions have the resources and the experience in educating nontraditional adult students and many in New Jersey already offer computer science programs and industrial technology programs, with high priority given to computer-aided manufacturing and nontraditional manufacturing processes.

A large portion of this student body already works full time. Three of our State colleges have just completed the first semester of a program for 300 members of the Communication Workers Union who are also State employees in data processing.

Rather than talk in generalities, I would like to describe to you briefly a model training program for adult employed workers which, if successful, could contribute useful strategies, I believe, for dealing with the millions in the work force eager to upgrade themselves.

This proposed program addresses the specific needs of two groups of workers in New Jersey: machinists and office workers, who already face the need to deal with technological innovation in the form of industrial robots, numerical control, CAD/CAM, word processors, and computerized information systems.

This experimental education program will include the development, implementation, and evaluation with a totally new curriculum at several New Jersey State colleges for this growing constituency of highly motivated, nontraditional students who work in offices and as machinists.

We have chosen to work with two trade unions, the International Association of Machinists and the Communication Workers of America, who represent 20,000 machinists and 60,000 office workers in the New Jersey area.

Each labor organization has a longstanding and deep involvement with the issues of technological change at the workplace and a record of serious commitment to worker education programs.

The interest of the trade union movement in helping educate its members has deep roots. Some of the most vigorous early campaigning for free public schooling came from the craft organizations which eventually became the American Federation of Labor.

These two unions, together with technological experts and faculty and the worker/students selected will help from the very beginning in setting educational goals which flow from their own work life experience. This, I believe, will insure a learner-relevant curriculum that is technologically rich and practical, and a course of study that helps the learner understand and participate in the social transformation which is underway.

What makes the implementation of these programs feasible is the shared recognition within these three separate groups—the trade unions, the State colleges and the Department of Higher Education of New Jersey—that they have related interests and policies and complementary resources.

The Department of Higher Education is concerned about educating the many different levels of manpower needed to preserve and attract high-tech industry into New Jersey. The IAM and CWA are deeply concerned about the deskilling and displacement of their workers as a consequence of automation.

The State colleges, which have the teaching resources in industrial technology and computer science are anxious to attract this new, nontraditional constituency of students who work on the front line of technological innovation.

These worker/students can help enrich the quality and sharpen the relevance of the schools' programs. They would also increase community awareness of new retraining possibilities.

The curriculum developed by these three—the college faculty, the trade union leaders and consultants—will have two distinct tracks. One will focus on general competence with computers and other technological innovations and on the application of computers to the learner's field of work.

This will be built upon the past experience of these workers and will provide new skills and knowledge to give them occupational flexibility. This differentiates this program from many proprietary, as well as customized training efforts that answer to the specific needs of a specific factory or industry at a specific moment and provide a very narrow range of additional skills that are not easily transferrable.

In contrast, this curriculum will provide enough basic understanding of an area so the learner can go forward by himself and it will give him or her the ability to transfer easily to an alive field.

The skilled curriculum will be tailored to meet the separate and unique needs of both the office workers and the machinists.

The second track, equally as important to both office workers and machinists, will focus on the relationship between technological change and work. It will look critically at the impact that computers and other technological innovations have on workers and society.

I would just like to conclude, then, by saying that we hope that these courses for technology and society will help to demystify technology and help the workers understand that technology is not some deterministic force controlling their lives, but can be guided by humans to benefit workers and the work process.

Like all the Nation, New Jersey is wrestling with its own self-regeneration. Its educational, technological, and scientific leadership see better and more broadly based schooling as one crucial starting point. There is particular concern about bringing educational opportunity to the adult working woman and man.

This group, through one of its organizational forms, the trade union, has shown its interest in pursuing new knowledge.

On the broad social level, we believe this program has implications for the role of postsecondary education in preparing an enormous sector of society for the changing national worklife ahead.

Adults may begin to see the return to the classroom, not as something to be feared, but as both a necessity and an opportunity. Employers may be encouraged to augment publicly available educational opportunity with more in-house training to those in blue- and white-collar positions. We hope that Government policymakers may be encouraged to allocate more resources to the kinds of technological education that produces, not just skills, but produces an ever more informed and involved citizenry.

All this will make the newly educated worker a more effective citizen in meeting the problems and possibilities of the new technological era that is upon us.

[The prepared statement of Dr. Levin follows:]

Statement Prepared

by

Hannah Levin

AUTOMATED MACHINES AND HUMAN AUTONOMY
AN EDUCATION AND RETRAINING PROGRAM FOR TRADE UNIONISTS

INTRODUCTION

The nature of work is changing at an accelerating tempo and as factories and offices introduce successive waves of new technology, the structure of the American workplace is being fundamentally reshaped. The choices made relating to education of those presently in the work force will be crucial as the nation shapes its economic and social future.

Those who make social policy decisions must confront the challenge of automation with new educational initiatives, initiatives that preserve and imaginatively expand the role of the human actor at work. It would be socially destructive if just as we move into the liberating potential of the "Information Age," untapped human resources were neglected, and the American workplace became less challenging.

One hundred years ago the Industrial Revolution also obliterated existing labor patterns. Then the nation's public school system played a vital role in preparing a burgeoning work force for a mass production economy. As our agrarian society industrialized, basic literacy was an imperative.

Today the nation again faces awesome educational obligations. A major debate has already begun on how to best strengthen science and mathematics teaching. In many public schools there is a drive for computer literacy that begins in the early grades while leading colleges and universities are now insisting that all students take courses in the hard sciences.

There is a crucial area of education, however, that is not getting adequate attention or support; retraining of employed adult men and women who may soon face job loss or downgrading because of technological advances. Seventy-five percent of those working today will still be in the workforce in the year 2,000. They must be prepared for change. It's estimated that in the past decade close to 40 million workers have had to change jobs or endure unemployment because of our changing and turbulent economy.

As a result there is a new awareness in the workforce that employability is ever more dependent on access to educational programs that deal with the new technology. We do not need narrow, short term, quick fix programs that are revolving doors to repeated displacement and deskilling. We must have instead a well planned program that provides workers with new high tech job skills, the requisite educational foundations to insure flexibility and an understanding of the impact of technological change on work. All this so that our future work force will be more able to adapt and participate fully in the new technological world.

The obligation falls increasingly on the institutions of higher education, particularly the public county and state colleges. These institutions have the resources and the experience in educating non-traditional adult students, and many in New Jersey already offer computer science programs which use micro-computers, mini-computers and some larger systems. In addition several schools have industrial technology programs, which give high priority to programs in Computer Aided Manufacturing and Non-Traditional Manufacturing Processes. A large portion of the student body at these public higher education institutions also work full time. And three of our State Colleges have just completed the first successful semester of a program to train 300 state employees in data processing.

Rather than talk in generalities I would like to describe to you briefly a model training program for adult employed workers, which if successful, could contribute useful strategies for dealing with the millions in the workforce eager to upgrade themselves.

Certain basic assumptions underlay my thinking as I developed this program. I believe that:

- The United States has fallen behind in developing the potential of its labor force.

- Our response to this failure has often been characterized by reactiveness to fill in a gap rather than an integrated attempt at long range planning. Thus we often find ourselves with short term inadequate training programs rather than with a long term well planned life-long education approach.

In our current rush to bolster technological training however, we should also strive as educators.:

- To prepare humans to meet society's needs.
- To prepare humans to meet their own needs.

I also believe that if an adult technological educational program is of value it merits college credit.

I think each sector of the higher education community has an important contribution to make to retraining and has something to contribute to preparing society for the introduction of technology. Each can learn much from the other and a better coordination of these segments is imperative.

Finally I believe the most fruitful planning approach is one that includes the thinking and experience of the potential trainees. In the pilot program I will now describe, we have tried to plan with the workers and their trade unions, not just for them.

This proposed program addresses the specific needs of two groups of workers, machinists and office workers, who already face the need to deal with technological innovation in the form of industrial robots, numerical control, CAD/CAM word processors and computerized information retrieval systems. This experimental education program will include the development, implementation and evaluation of a new curriculum at several New Jersey State Colleges, for this growing constituency of highly motivated non-traditional students who work in offices or as machinists.

We have chosen to work with two trade unions, the International Association of Machinists (IAM), and the Communication Workers of America, (CWA), who represent 20,000 machinists and 60,000 office workers in the New Jersey area. Each labor organization has a long standing and deep involvement with the issues of technological change at the work place and a record of serious commitment to worker-education programs. The interest of the trade union movement in helping educate its membership has deep roots. Some of the most vigorous early campaigning for free public schooling came from the craft organizations which eventually became the American Federation of Labor.

These two unions together with technological experts and faculty, and the worker/students selected will help from the very beginning in setting educational goals which flow from their own worklife experience. This I believe will insure a learner relevant curriculum that is technologically rich and practical, and a course of study that helps the learner understand and participate in the social transformation which is underway.

What makes the implementation of this unique kind of program feasible is the shared recognition of the three separate groups, trade unions, the state colleges, and the Department of Higher Education that they have related interests and policies and complementary resources. The Department of Higher Education is concerned about educating the many different levels of manpower needed to preserve and attract high-technology industry into New Jersey. The IAM and the CWA are deeply concerned about the deskilling and displacement of their workers as a consequence of automation. And the State Colleges, which have the teaching resources in industrial technology and computer science are anxious to attract this new non-traditional constituency of students who work on the front line of technological innovation. These worker/students can also help enrich the quality and sharpen the relevance of ths schools/ programs.

BACKGROUND

The State of New Jersey's strategy for dealing with the shift away from a traditional manufacturing economy finally crystallized last year. The governor appointed a distinguished group of citizens to a Commission on Science and Technology. Its mandate was to develop a broad program that would bolster and expand the high technology elements already in place in the economy. Recognizing, further, that education provides a vital link between economic development and skilled manpower, the Task Force on Technology-Trained Manpower was established as one of the four major working bodies of the Commission. The Task Force has identified four major areas of concern with respect to a technologically-trained labor force. These include:

- A critical need for improved levels of mathematics, science and technical education; the pressing resource problems, particularly with respect to both faculty and equipment; the need for a coordinated system of continuing professional education to address problems arising from the rapid expansion of knowledge and related occupational obsolescence; a growing need for both training and retraining programs for technical and subtechnical support personnel.

These concerns reflect the recognition that the restructuring of society from an industrial to an information economy calls for a concomitant restructuring of educational goals and programs.

Funds needed to support these new programs have been sought from a variety of sources. Those to be used for educational innovation, faculty training and curriculum development were requested from FIPSE (Fund for Improvement of Post Secondary Education). Support for equipment from federal Vocational Education funds and State Science and Technology funds is being sought. Tuition rebate agreements are already in effect in the CWA and IAM contracts to support tuition costs.

CURRICULUM

The curriculum developed by college faculty, trade union leaders and consultants will have two distinct tracks. One track will focus on general competence with computers and other technological innovations and on the application of computers to the learners' field of work. This portion of the curriculum, built upon the experience of these workers will provide new skills and knowledge to give them occupational flexibility. This differentiates this program from customized training efforts that answer to the needs of a specific factory or industry and provide a very narrow range of additional skills that are not easily transferable. In contrast this curriculum will provide enough basic understanding of an area so that the learner can continue development through self-direction including the ability to transfer easily to an allied field. The Skill curriculum will be subdivided into two series of courses tailored to meet the separate and unique needs of both the office workers and machinists.

The second track, offered to both office workers and machinists, will focus on the relationship between technological change, work and society. Several interdisciplinary courses will look critically at the history, use and impact that computers and other technological innovations have on work, workers and society.

Some of the suggestions for the curriculum received from separate participants are listed below. It must be emphasized that only through the process of the unionists, academicians and the consultants working together will a final consensus be reached on the exact design and sequence of courses. This is another unique feature of this program.

Technological Skills Course for Machinists and CWA Workers

Introduction to Computer Programming

The basics of the computer program will be reviewed using a higher level language such as Basic. The programming principles of looping, logic and control structures and arithmatic statements will be taught on the microcomputer.

Technological Skills Course for Machinists

1. Programming for CAD/CAM

This course presents a comprehensive introduction to a high level language and software development for use in CAD/CAM systems, methods and applications. Emphasis is placed on the practical aspects of the language and its use in automating the design and manufacturing processes and implementing the CAD and CAM systems into planning, costing, data-base design, productivity measurement standards, design and automated production.

2. Computer Numerical Control, Manual Programming

Manual programming as related to point to point and continuous path machining will be experienced by participants. Tape systems, computer numerical control systems (CNC), setup and operation will be addressed. An emphasis will be placed on mill and lathe control operations.

The basics of a computer program will be reviewed in general. A great deal of information transfer is anticipated between the machinists and instructor in the course due to the complexity of various machine characteristics and the art of both machining and programming. Various interactive systems will be introduced such as Layout and TRAC.

Second Year

3. Computer Programming Numerical Control (Computer Aided Manufacturing, CAM)

Computer language programming as related to numerical control will be studied. An introduction to the APT (Automatically Programmed Tools) language will be taught.

The function and operation on controls, printers, plotters, and tape punch/readers will be discussed. Other software systems will be introduced.

4. Non-Traditional Manufacturing Processes

Specialized high technology production processes such as electrical discharge machining, electrical chemical milling, electron beam welding, laser beam welding, and cutting will be studied. The application of computer numerical control and robotic interaction where appropriate, will be discussed. This course will include flexible manufacturing systems and machining centers.

Technological Skill Course for Communication Workers

1. Computer Graphics

This course will include an overview of computer graphics, the use of various graphics packages, the developing of graphs and transparencies, developing two and three dimensional images, color graphics and word processing.

2. Computer Aided Design Techniques

The basics of using computer aided design programs. These programs allow the user to interact by choosing the components (parts) of a system and combining them through the program into a viable system. This is all illustrated on a graphics computer terminal and the results are stored for future use. This is indeed a simulation of the system that can be tested before the systems are actually constructed. It is projected that new systems in the 1980's and 1990's will be designed in this fashion.

3. Business Programming Languages

Depending on the specific characteristics of the students workplace they will be introduced to an an appropriate high level language that will help them to understand the computer solution to office and business problems. The basics of AINS Cobol Language, Algorithms used in the solution of Business Problems, structured programming, and Table Handling will also be taught.

4. Systems Analysis and Design

Systems design for and by the user will be the focus of this course. Topics will include the systems concept, information systems, systems analysis, systems environment and constraints, output requirements, performance and processing, input requirements and control measures, systems design, user requirements, hardware requirements, file design, input/output design, project documentation, system testing, implementation and maintenance.

SUGGESTED CURRICULUM IN TECHNOLOGY AND WORK FOR BOTH IAM & CWA WORKERS

The purpose of these courses would be to demystify technology. By the use of lectures, films, case studies and newspaper articles the students would develop the critical and analytic ability to evaluate a particular technological innovation at work and what it can and cannot do. The goal would be to have the students understand that technology is not some deterministic force controlling their lives but can be guided by humans to benefit workers and the work process. We would hope to lay the informed substantive basis for choice. People can make choices of how to use these new tools if they understand them.

1. A history of technology and its impact on the worker and the organization of work.
2. An introduction to technological thinking. The use of quantitative approaches, modeling and systems theory to problem solving in the work-place.
3. The difference between computer users and computer programmers.
4. Comparison of Human Centered Systems with Computer Centered Systems.
5. Relation of technological innovation to social innovation.
6. Computer use that enhances human skill and ability. Analogic part programming compared with conventional symbolic part programming. Telecheric devices.
7. Economic implications of the New Technology.
8. Political implications of the New Technology.
9. Human/machine comparisons. Intuition, subjectivity and imagination compared to quantifiability, predictability and reliability.
10. Robots - friend or competitor?
11. Human/machine interactions.
12. Prototyping and user friendly systems.
13. Knowledge obsolescence - and its implications for training programs.

14. Approaches to technological change being implemented in Western Europe by unions, management and government.
15. The Technological Steward in Norway "Before the fact and After the fact" training approaches.
16. The impact of the new technology on traditionally gender related occupations.
17. Data banks and privacy.
18. Deskilling, increased tempo of work and stress.
19. Keeping work meaningful. What technology does produce and what it could produce.
20. Technology and democracy, automation and human autonomy.

Each class will discuss the problems and the possibilities related to the above topics. Included in these discussions will be questions of organization of the work process, skilling and deskilling, grievance control, retraining, safety, and legislative issues.

The discussion of the above topics will always be related to specific examples of technology such as: computer hardware and software uses in manufacturing, the office, design and assembling; mainframe, mini and microcomputers at the work place; numerical control programming in the machine shop; computer aided design methods, computer aided manufacturing, robotics, word-processors and data information systems.

ANTICIPATED OUTCOMES

We anticipate the following outcomes for this program:

Short term

1. Workers will learn new skills.
2. Workers will have new knowledge and understanding of technology.
3. Workers will remain employed and not be deskilled.

Longer term effects

4. Help unions implement their technology steward program.

5. Serve as a model to other unions who are facing similar problems including development and dissemination of an educational model, and materials that have been tested and evaluated, to the other state colleges, and to other unions who have tuition rebate clauses in their contracts, but which thus far have not been used in a systematic and meaningful fashion.
6. Developing a new non-traditional constituency for the state colleges of mature motivated trade-unionists which could result in institutional reforms related to instruction and curriculum.
7. As a model it could lead to increasing the number of workers in New Jersey with high technology skills. Also it could develop the proficiency of regular faculty to teach technology related courses which would make the state more attractive to high-technology companies. This should also expand employment opportunities.
8. By enriching the intellectual content of work and by making education more relevant to one's occupation, these programs should contribute to work and education becoming more meaningful to the participants and to a decrease in the sense of alienation among workers threatened by cutbacks.

CONCLUSION

Like all of the nation, New Jersey is wrestling with its own self regeneration. Its educational, technological and scientific leadership see better and more broadly based schooling as one crucial starting point. There is particular concern about bringing educational opportunity to the adult working man and woman. And this group, through one of its organizational forms, the trade union, has shown its interest in pursuing new knowledge. We believe the pilot program we have outlined will demonstrate the potential of this group and the capacity of the state college system to attract this vital segment of the citizenry.

On the broadest social level, we believe this program has implications for the role of post-secondary education in preparing an enormous sector of society for the work-life ahead. Adults may begin to see the return to the classroom not as a threat but as both a necessity and opportunity. Employers may be encouraged to augment publicly available educational opportunity with more in-house training to those in blue and white collar positions. Government policy makers may be encouraged to allocate more resources to technological education that produces an ever more informed and involved citizenry. All of this will make the newly educated worker a more effective citizen in meeting the problems and possibilities of the new technological era that is upon us.

Mr. GEPHARDT. Thank you very much.

Dr. Swain.

[The biographical sketch of Dr. Swain follows:]

DONALD C. SWAIN

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Office: Office of the President
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Personal Information

Born: Des Moines, Iowa, October 14, 1931

Married: March 5, 1955 to Lavinia Lesh Swain

Children: Alan Christie (Son)
Cynthia Catherine (daughter)

Education

1949: Graduated, Roosevelt High School, St. Louis, Missouri

1953: B. A., University of Dubuque

1958: M. A. (History), University of California, Berkeley

1961: Ph. D. (History), University of California, Berkeley

Military Service

1953-56: Lieutenant (j.g.), U. S. Navy

Professional Experience

1961-63: Assistant Research Historian, University of California, Berkeley

1963-67: Assistant Professor of History, University of California, Davis

1967-70: Associate Professor of History, University of California, Davis

1970-81: Professor of History, University of California, Davis

1981 - Professor of History, University of Louisville

Administrative Service

1966-67: Academic Assistant to the Chancellor
University of California, Davis

1971-72: Assistant Vice Chancellor--Academic Affairs/Student Affairs
University of California, Davis

1972-75: Vice Chancellor--Academic Affairs
University of California, Davis

1975-81: Academic Vice President
Systemwide Administration
University of California

1981 - President
University of Louisville

Dr. Swain. Thank you, Mr. Chairman.

My name is Donald C. Swain and I am president of the University of Louisville. Before I came to the University of Louisville, I was with the University of California and had the pleasure of working with the State legislature rather intensively and got to know Mr. Dymally. It is a pleasure to see Mr. Dymally here.

I am pleased to have this opportunity to present my views on the current and future roles of higher education in preparing individuals to function in a rapidly changing work environment. In my opinion, few, if any, subjects are more fundamental to American economic development in the 1980's, and no other subject deserves more careful thinking in strategic planning for American universities in the next decade.

The American economy is unmistakably and quickly changing. The pace of change seems to accelerate each month, driven by technological developments and a host of other social and economic forces. The pattern is clear and unforgiving.

In this environment, what can universities, industry, and Government do? How shall we react to the unprecedented changes in our economy?

My suggestions are based mostly on my experience as the president of the University of Louisville and on what is happening in Kentucky, a State whose economy is in transition and where adaptation to a new future is now underway.

First, let me note that it has become absolutely clear to me and to other leaders in Kentucky that quality education is the key to our future. Nothing is more fundamental than this. We must appreciate quality more fully and support it more completely.

I am happy to say that many Kentuckians are demanding responsiveness on this point from public officials and educators in our State. A commitment to quality in education should begin in one's own home precincts and it has in Kentucky, I think. But it also must be reflected in the Halls of Congress and in Federal policy.

I suggest that you make the recognition of and attainment of quality in education and retraining a major underlying theme at these hearings. Let that theme infuse all of your subsequent legislative initiatives.

I propose that you—to borrow a phrase—ask not what our universities can do for the Congress; but rather, ask what the Congress can do for our universities.

Such a fresh perspective could help all of us: future employers, taxpayers, students, teachers, public officials, and, yes, even university presidents to encourage higher levels of expectation and performance in our educational institutions. Quality, then, the search for quality, is the first point.

A second point has become obvious in Kentucky and elsewhere. The brisker the pace of technological change, the more compelling are the arguments for solid, general education in the basics. Writing, analyzing quantitatively, thinking independently, and learning how to learn. Universities must continue educating specialists, of course. We must also do our best to respond to the needs of employers who want well-trained people to fill specific positions.

But given the flux of the marketplace and the fact that in about 5 years, most current technical information will be obsolete, universities—and I would argue, in fact, all levels of education—must teach people, first and above all, to continue to learn, to be reasonably comfortable with ambiguity and to be prepared to retrain.

More than ever, high school diplomas and college degrees are not end points; they simply document judgments that the graduates are ready to start a lifetime of learning.

I want to point out that to make retraining programs effective in the long run, we must conceptualize retraining as one of the normal, predictable processes of adult life. And then inculcate that notion in school children and university students well before they themselves may need retraining.

Federal policies should encourage this; high schools and universities must practice it; employers must support it.

In Louisville, at least, employers are more and more expecting to train and then retrain their own employees. They want an adaptable, generally educated work force that can be trained and retrained as needed. This is a trend that both educators, and industrial, and business leaders must come to terms with in future years. Congress must come to terms with it, too.

My third point is about universities. It is fashionable to lament their slowness to change. I, myself, have sometimes led the lamentation, but I must say, important changes are now occurring and mirroring the pace of change in general. These are taking place with surprising speed.

This is especially true in the wide range of new cooperation between businesses and universities for the purpose of solving educational problems, encouraging research, and getting things done that are mutually beneficial.

Some of these cooperative enterprises are very imaginative. Let me give you two examples from the University of Louisville. Many more could be gleaned, of course, from a nationwide survey.

Two years ago, our teaching hospital, like many others around the country, was on the brink of bankruptcy. An indispensable asset to our community, it was in danger of having to close. It became clear to me that the university would be wise to seek a financially sound partner, one who would share the university's commitment to quality, but who would be able to provide the cash flow and working capital necessary to assure the financial stability that public agencies could not assure for our teaching hospital.

Humana, Inc., a for-profit hospital firm that owns and operates many hospitals around the world, responded boldly. Our negotiations were difficult, but we persevered. We were doing some pioneering, and I am proud of that.

Eventually we agreed to a long-term lease of the university's new hospital to Humana and an affiliation agreement for the university's medical teaching programs to be offered in that hospital.

We also agreed with the State, the county, and the city on an indigent-care contract that may have permanently solved the indigent-care problem in Louisville. Not many cities can make that statement.

Incidentally, employees of the old hospital had to be retrained to work in the new hospital, and that, too, was part of our agreement.

Humana fully intends to run a profitable, teaching hospital in Louisville, and the University of Louisville intends to help them. If the new hospital, which is called Humana Hospital University, is to be a financial success, quality is the key. Both the partners understand that. We have every incentive to build quality together.

If we are successful—this is part of the innovative quality of the agreement—the university will receive 20 percent of the pretax profits at Humana Hospital University. The money will then be reinvested in our health-care programs to make them even better in the future.

The University of Louisville was the first university in the country bold enough to enter into this kind of new partnership with a for-profit corporation for the purpose of running a teaching hospital.

Humana was the first corporation to realize the immense potential of such an agreement and to be willing to undertake the risks. We cannot be certain of success, but we are pleased with our association. It is an example of the kind of bold and imaginative working relations now beginning to emerge across the country between universities and businesses.

The Nation will see much more of this, I believe, as the 1980's proceed. Economic development, research work, teaching programs, training and retraining efforts, and other collaborations can be carried out using this partnership model.

Another example worth noting is in our engineering school, Speed Scientific School, at the University of Louisville. The faculty has decided on an ambitious new emphasis on computer-aided engineering [CAE] which will require the acquisition of the latest computer hardware and software and the strong support of the community. The program calls for a new CAE facility and includes automated manufacturing research laboratories and joint university-industry research programs.

All of this will be developed, I believe, because it responds to educational and research needs in the community and is beneficial to the industrial concerns that will pay for it; that will hire the engineers and use the facilities and programs for special training and retraining efforts.

Gradually, corporate organizations are sensing that universities are, indeed, adaptable and can be entrepreneurial. Universities, too, are learning that corporations and industrial firms, where their vital interests converge with university needs, can be honorable and dynamic partners.

The fourth insight on the rise in Kentucky and elsewhere is that fundamental research of high quality pays off in economic development. It must be high-quality research; mediocre work is wasteful and will pay little or no dividend in economic terms.

Obviously, this has been true of universities for a long time, and this has been true since at least the late 19th century, but public policymakers, speaking of retraining, need to retrain themselves in the validity of this truism from time to time. Now is one of those times.

Federal support of research has never been more important to the Nation than now. It builds new knowledge and intellectual vitality; it promotes quality in higher education; it stimulates economic development.

In summary, then, I have advocated:

First, that you emphasize quality and take steps to build the highest possible quality in educational training and retraining programs;

Second, that you recognize the fundamental fact that rapid technological change produces greater, not lesser needs, for general education, focusing on the basics, such as writing, quantitative analysis, independent thinking and learning to learn;

Third, that new partnerships between universities and businesses need to be nurtured; and

Fourth, the United States of America should make a greater commitment to research for many reasons, but certainly because it pays off in economic development and quality higher education.

Let me just take one final minute with some specific proposals if I may.

First, retraining can be offered most effectively when it is offered on neutral turf and sponsored jointly by labor and management. Labor-management relations centers at universities, for example, should be encouraged to sponsor such retraining programs. Federal funds appropriated for this purpose could be put to targeted use in the next several years and then later shifted to research and continuing efforts to educate Americans to understand retraining as a normal part of life.

Second, tax incentives should be adopted to encourage useful, synergistic partnerships between universities and for-profit corporations. If sufficient public funds are not directly available to support research, provide needed equipment for research and teaching and encourage quality in education, tax incentives can afford indirect support.

Third, Federal financial support should be available for universities that undertake a leadership role in economic development, concentrating on those areas of the country which have the greatest need for economic assistance.

Fourth, urban universities should be recognized as special educational resources already tackling problems of retraining, economic development and research in the urban areas of the United States where the impact of technology on employment is often magnified. The urban universities could do for our cities what the land-grant universities have done for agriculture and rural society.

Fifth, financial support for research should be increased and trust must be restored between the Federal Government and the researchers who obtain Federal contracts and grants. Narrow regulation is self-defeating in research.

Sixth and finally, we must take the long view. This is often difficult in American society regarding the problems you are studying. In my opinion, there are no quick fixes or radical solutions. Sustained efforts are needed to build quality, expand research and encourage innovation in higher education.

Federal policies to achieve these goals must be consistent and sustained. We will be working on these problems, I believe, for the foreseeable future.

[The prepared statement of Dr. Swain follows:]

Testimony of
President Donald C. Swain
University of Louisville

My name is Donald C. Swain, and I am President of the University of Louisville.

I am pleased to have this opportunity to present my views on the current and future roles of higher education in preparing individuals to function in a rapidly changing work environment. Few, if any, subjects are more fundamental to American economic development in the 1980's; no other subject deserves more careful attention in strategic planning for American universities in the next decade.

The American economy is unmistakably and quickly changing. The pace of change seems to accelerate each month, driven by new technological developments and a host of other social, political, and economic factors. The number of manufacturing jobs is decreasing. Information-based and service jobs are increasing. Automated manufacturing processes are expanding. There are more paying jobs that require familiarity with computers and information processors and fewer jobs that require simple physical strength. The world is smaller and more interconnected than before, as the computer and telecommunications revolution roars on. The global economy is a reality. The lead time for planning is drastically foreshortened.

In this environment, what can universities, industry, and government do? How shall we react to the unprecedented changes in our economy?

My suggestions are based mostly on my own experience as the President of the University of Louisville and on what's happening in Kentucky, a state whose economy is in transition and where adaptation to a new future is now underway.

First, let me note, it has become absolutely clear to me and other leaders in Kentucky that quality education is the key to our future. Nothing is more fundamental than this. We must appreciate quality more fully and support it more completely. We must have more of it--in all forms. I'm happy to say that many Kentuckians now perceive quality education as a necessity not a luxury, and they are demanding responsiveness on this point from public officials and educators.

Admittedly, a commitment to quality education should begin in one's home precincts, but it also must be reflected in the halls of Congress and in Federal policy. I suggest that you make the recognition and attainment of quality in education and retraining a major underlying theme at these hearings, and let that theme infuse all of your subsequent legislative initiatives. I propose that you ask not what our universities can do for the Congress; ask what the Congress can do for our universities. Such a fresh perspective could help all of us--future employers, taxpayers, students, teachers, public officials, university presidents--to encourage higher levels of expectation and performance in our educational institutions.

A second point has become obvious in Kentucky, and elsewhere. The brisker the pace of technological change, the more compelling are the arguments for solid, general education in the basics--writing, analyzing quantitatively, thinking independently, and learning how to learn. Universities must continue educating specialists in engineering, science, law, medicine, education, and many other fields. We must also do our best to respond to the needs of employers, who want well trained people to fill specific positions. But given the flux of the marketplace and the fact that in about five years most current technical knowledge will be obsolete, universities (in fact all schools) must teach people, first and above all, to continue to learn, to be reasonably comfortable with ambiguity, and to be prepared to retrain.

More than ever, high school diplomas and college degrees are not end-points; they simply document judgments that graduates are ready to start a lifetime of learning. I want to point out that to improve retraining programs in the long run, we must conceptualize retraining as one of the normal, predictable processes of adult life, and then inculcate that notion in school children and university students well before they themselves may need retraining. Federal policies should encourage this. High schools and universities must practice it. Employers must support it.

In Louisville, at least, employers are more and more expecting to train (and retrain) their own employees; they want an adaptable, generally educated workforce that can be retrained (and retrained) as needed. This is a trend that both educators and industrial and business leaders must come to terms with in future years. Congress must come to terms with it, too.

My third point is about universities. It is fashionable to lament their slowness to change. I myself have sometimes led the lamentation. But, I must say, important changes are now occurring and, mirroring the pace of change in general, these are taking place with surprising speed. This is especially true in the wide range of new cooperation between businesses and universities for the purpose of solving educational problems, encouraging research, and getting things done that are mutually beneficial. Some of these cooperative enterprises are very imaginative. Let me give you two examples from the University of Louisville. Many more could be gleaned from a nationwide survey.

Two years ago, our teaching hospital, like many others, was on the brink of bankruptcy. An indispensable asset to our community, it was in danger of having to close. It became clear to me that the University would be wise to seek a financially sound partner, one who would share the University's commitment to quality but who would be able to provide the cash flow and working capital necessary to assure the financial stability that public agencies could not assure. Humana, Inc., a for-profit hospital firm that owns and operates many hospitals around the world, responded boldly.

Our negotiations were difficult, but we persevered. We were doing some pioneering. Eventually, we agreed to a long-term lease of the University's new hospital and an affiliation agreement for our medical teaching programs. We also agreed--with the state, county, and city--on an indigent care contract that may have permanently solved the indigent care problem in Louisville. Employees of the old hospital had to be retrained to work in the new hospital. Centers of excellence were to be developed.

Humana fully intends to run a profitable teaching hospital in Louisville, and the University intends to help them. If the new hospital (Humana Hospital University) is to be a financial success, quality is the key. Both partners understand that, and we have every incentive to build quality together. If we're successful, the University will receive 20% of the pretax profits at Humana Hospital

University; the money will then be reinvested in our health care programs to make them even better in the future.

The University of Louisville was the first university in the country bold enough to enter into this new kind of partnership with a for-profit corporation. Humana was the first corporation to realize the immense potential in such an agreement and to be willing to undertake the risks. We can't be certain of success, but we're pleased with our association. It is an example of the kind of bold and imaginative working relations now beginning to emerge, across the country, between universities and business.

The nation will see much more of this, I believe, as the 1980's proceed. Economic development, research work, teaching programs, training and retraining efforts, and other collaborations can be carried out using this partnership model. Appropriate contractual safeguards are needed to insure the academic freedom of researchers and teachers. Appropriate contractual recognition of the corporation's legitimate interest is also necessary to assure clarity in the partnership

Another example worth noting is in our engineering school (Speed Scientific School). The faculty has decided on an ambitious new emphasis on computer aided engineering (CAE) which will require the acquisition of the latest in computer hardware and software.

The program also calls for a new CAE facility and includes an automated manufacturing research laboratory and joint university-industry research programs. All of this will be developed, I believe, because it responds to educational and research needs in the community and is beneficial to the industrial concerns that will pay for it, hire the engineers and use the facilities and programs for special training and retraining efforts. Gradually, corporate organizations are sensing that universities are indeed adaptable and can be entrepreneurial. Universities, too, are learning that corporations and industrial firms--where their vital interests converge with university needs--can be honorable and dynamic partners.

Timely change is needed as never before. We do not want to establish economic development and retraining programs, only to discover, after lag-time for planning, that they're no longer necessary. Partnerships between universities and business organizations speed up the process of change from the University's perspective and make it more deliberate from the corporation's viewpoint. The modified pace each way is probably healthy.

A fourth insight, on the rise in Kentucky and elsewhere, is that fundamental research of high quality pays off in economic development. It must be high quality research. Mediocre work is wasteful, and will pay little or no dividend in economic terms. Of course, in a university, research lies at the very heart of the attainment of quality. This has obviously been true since the late 19th century, but public policymakers need to retrain themselves in the validity of this truism from time to time. Now is one of those times. Federal support of research has never been more important to this nation. It builds new knowledge and intellectual vitality. It promotes quality in higher education. It stimulates economic development. It can contribute to the national defense. It helps us deal with increasing complexity. It is indispensable to our national well-being--an investment in our own future. We need to increase our investment.

In summary, then, I have advocated:

1) That you emphasize quality and take steps to build the highest possible quality in our educational, training, and retraining programs.

2) That you recognize the fundamental fact that rapid technological change produces greater, not lesser, needs for general education focusing on the basics, such as writing, quantitative analysis, independent thinking, and learning to learn. We should teach our citizens to expect and be prepared for retraining; it's a normal part of adult life. Universities should expand their continuing education and retraining programs accordingly.

3) That new partnerships between universities and businesses need to be nurtured. Many of these are bold and imaginative. With proper safeguards, they can help us accomplish much needed research, educational, or retraining objectives. The suspiciousness of such arrangements, which has been pronounced in the past, should be reexamined. Encouraging policies (carefully drawn) should replace discouraging policies.

4) The United States of America should make a greater commitment to research for many reasons, but certainly because it pays off in economic development and quality higher education.

Now, some specific proposals:

1) Retraining can be offered most effectively when it is offered on neutral turf and sponsored jointly by labor and management. Labor-Management Relations Centers at universities should be encouraged to sponsor such retraining programs. Federal funds appropriated for this purpose could be put to targeted use in the next year or two, and later be shifted to research and continuing efforts to educate Americans to understand retraining as a normal part of life.

2) Tax incentives should be adopted to encourage useful, synergistic partnerships between universities and for-profit corporations. If sufficient public funds are not directly available to support research, provide needed equipment for research and teaching, and encourage quality in education, tax incentives can afford indirect support.

3) Federal financial support should be available for universities that undertake a leadership role in economic development, concentrating on those areas of the country which have the greatest need for economic assistance.

4) Urban universities should be recognized as special educational resources, already tackling problems of retraining, economic development and research in the urban areas of the United States where the impact of technology on employment is magnified. The urban universities could do for our cities what the land grant universities have done for agriculture and rural society.

5) Financial support for research should be increased and trust must be restored between the federal government and the researchers who obtain federal contracts and grants. Narrow regulation is self-defeating in research.

6) We must take the long view. This is often difficult in American society. Regarding the problems you are studying, there are no quick fixes or radical solutions. Sustained efforts are needed to build quality, expand research, and encourage innovation in higher education. Federal policies must be consistent. We will be working on these problems for the foreseeable future.

Mr. **Gephardt**. Thank you very much.

We have a vote on now, so I think we will take a 10-minute break and make the vote. We will be right back. Thank you.

[Recess.]

Mr. **Gephardt**. I think we are ready to resume.

Our next witness is Dr. Gene Bottoms, who is Executive Director of the American Vocational Association. We are happy to have you and welcome your testimony.

[The biographical sketch of Dr. Bottoms follows:]

James E. Bottoms

PRESENT:	Executive Director American Vocational Association
PAST EXPERIENCE:	Director of Educational Improvement Georgia State Department of Education
	Assistant Director of Vocational Education Georgia State Department of Education
	Guidance Director South Georgia Technical & Vocational School
	Elementary School Principal Georgia Public Schools
	Before entering education, worked in the private sector for such organizations as Sears & Roebuck, General Motors and Lockheed Aircraft.
EDUCATION:	University of Geogia:
	Bachelor of Education - 1960
	Master of Education - 1962
	Doctorate of Education - 1965
PERSONAL:	Married with three children age 14, 11 and 8.
	Serves on the Board of Deacons and is Director of the Adult Sunday School, Columbia Baptist Church

Dr. BOTTOMS. I am very pleased to have been invited to share thoughts with you on the role of institutions in training and retraining and to suggest possible Federal roles in that regard.

It is not too difficult to define what the role of institutions ought to be in the area of training and retraining. Certainly that role would include to work with employers to determine what jobs are or will be in demand and to deliver the programs that produce individuals with the knowledge and skills to occupy those jobs; to develop new programs and revise existing programs as technology changes; to provide new and entry-level workers with the appropriate knowledge and skills needed in jobs; provide free training opportunities for the unemployed and dislocated workers; and, in particular, I think it is important that public institutions assist particularly the smaller employers in upgrading and retraining their workers as they begin to make applications of advanced technology.

However, stating a desired role for an institution is a long way from marshaling a very diverse and decentralized network of institutions toward the training and retraining needs of this Nation.

In the testimony, I have tried to share with you some knowledge about the institutions in this country that provide training and retraining.

Mr. Chairman, in 1960, there were only 600 institutions in America that offered at least 6 vocational courses. Today, there are over 8,000. If you look at table 2 in the testimony, you will find out how those institutions divide themselves among community colleges, vocational technical schools, technical institutes, and comprehensive high schools.

I do not think many people realize the diversity and the decentralized nature of the institutions of this Nation that deliver this training. Second, you could classify vocational training into at least two basic types: First, a very general type designed to orient people to work, work attitudes, some common uses of tools and materials. They can enter a whole host of jobs. The second type, occupational-specific.

In the broader type, we have about 10 million people enrolled and in the occupation-specific programs, we have about 6 million people enrolled in this country—approximately 3 million at the secondary level, and approximately 3 million at the postsecondary and adult level. At the postsecondary and adult level, the average age is roughly 29; about 20 or 25 percent have had other forms of education before coming into some form of postsecondary or adult vocational education.

The occupational-specific programs range from dealing with broad occupational clusters to delivering job-specific training for a particular employer.

In pages 818 through 823 in the testimony, we show the results of a recent survey of some 16 States to look at ways in which this diverse set of institutions were, in fact, dealing with retraining.

We found four basic strategies being used. First, many States use what I call a quick-start training strategy, in which an employer needs to employ *x* number of new workers and in which one begins to connect the unemployed to employer-specific training programs so that those individuals are assured a job, and training is tailored very much to those employers' needs.

Most States now have that kind of capacity. Second, we found a lot of the institutions were mainstreaming into ongoing programs where they had open training slots for the unemployed. Third, some institution were adding a second shift if they could find the money to employ a second shift of faculty, particularly in those program areas where there is a demand for people, like electronics labs and some of the metal trades; and fourth, some institutions were developing youth programs where they could find the resources to do so.

To fully utilize this network of institutions to address the training and retraining needs, it is important to understand some of the difficulty that these institutions were having in keeping their programs current with the requirements of the workplace. Basically, they are having problems in keeping their instructional equipment state-of-the art to reflect the technology of the workplace.

In the testimony, I share with you a study that is about 18 months old, a survey of many of these institutions pointing out their difficulties. Second, I share with you a survey concluded on 288 institutions last December, pointing out that they were having to make some major compromises in holding and obtaining qualified staff because many of the graduates are being picked up by industry at higher salaries than schools could pay a beginning staff person in some of these particular technology areas.

Third, one of the problems we have in the field is that starting in the mid-1970's, up until the present, in real dollars, there has been a declining Federal participation in the Nation's programs of vocational and technical education.

The administration has built their case on reducing funding based on the premise that the State and locals were picking up those costs and, in fact, they were overmatching. I have provided for you data that shows that between 1978 and 1981, there has been a decline in State and local funding in this field. In selected States for 1982 for which I have been able to get data, there is a continuing decline, particularly in four states—States that have been hardest hit by the depression.

That decline has taken place in two primary areas. Where local school boards and community colleges have to make a decision about their priorities, they make a decision to keep the programs open during the day, but close down the adult phase. So a lot of the decline has been in dollars that would operate the programs on a second shift for serving adults.

We have limited capacity, particularly in the engineering technologies. I have provided to you a chart that shows enrollment growth in different fields over the past 15 years. The technology programs have only doubled.

On pages 842 and 843 I have identified for you particularly some of the engineering technology for which we simply lack the capacity in this country to prepare people. In fact, the public institutions of this Nation have a capacity to produce only abut 225,000 technicians. The demands by some go as high as 1 million. If you divide that in half, a half a million, we are far from the capacity that we need there.

There are many existing programs that need to be revised. I have listed most of those on page 847. One of those is auto body. Now most of you think that is a fairly simple trade, and we do not need to revise that. But the new unibody automobile has changed dramatically how automobiles are repaired in this country, and most of our labs' training programs simply do not have the technology to do that job. Electronic labs also are very much out of date.

Another point: We seem to have a growing shortage of advanced-level skilled workers in this Nation. If you look at Federal policy, we focus primarily on trying to get the economically disadvantaged in entry jobs and focus a great deal of effort on the college preparatory, which are fine.

But we have no colleges that focus on advanced-level technical and skilled jobs which are critical to the Nation's productivity.

I have provided several bits of evidence in this regard, but particularly, our best vocational and technical graduates from community colleges, from vocational technical schools since 1975, have been participating in the international skill olympics, competing against 14 other nations. I have provided you with two tables on pages 852 and 853 that show that we have done well enough in those competitions to come out 15th with our competitors in Western Europe and the Far East.

It is not that our students are not as bright. It is simply that we have never made our programs 4 years in length, nor as intensive in the math and science, nor with as much applied experience. We try to do in 2 hours a day what other countries do in 4 years, 6 to 8 hours a day. We simply have no system in this country to prepare advanced-level workers.

I shared with you a couple of examples in the testimony: One in Greenville, S.C.; another in Augusta, Ga., where they are trying to develop systems to produce advanced-level technical skill workers.

Another point: As you look at the changing nature of the workplace, at least we have concluded that the narrow craft approach is not adequate to prepare people for some of the emerging new technologies and some of the advanced-level skilled trade jobs.

We have to have a broader technical knowledge base, math and science base for certain occupations. In the appendix of materials, I have shared with you some materials that we used recently with a research firm out of Waco, Tex. We have conducted regional workshops across the country helping community colleges and vocational technical schools look at how to redesign their engineering technologies.

We have only 24 programs in this country that prepare people in laser-optic technicians, for example. Schools have to begin to revamp their technology programs to include not only craft approach, but to build a 75-percent broad base with 25-percent specialty.

I have given you some examples in that area. There are several States that are attempting to make some revisions in this area. Based on the need for training and retraining that we are faced with in this country, the diversity and decentralized nature of these 8,000 institutions that do the bulk of the vocational and technical training, it is very difficult in staying current, very difficult in finding resources to utilize their facilities to the maximum for training and retraining.

There is a particular need to expand in the engineering technologies and to revise and upgrade some programs where technology is changing the skill requirements.

It seems to us there are at least four possible Federal roles that you might want to think about. If you look at this field over the past 20 years, you will find that the major Federal role has been one to assist States to build the institutional capacity that now exists.

I suggest that a major Federal role over this decade and next will be to assist States to modernize these programs in terms of the changing requirements of the workplace. Modernization certainly includes building programs that can produce people at the advanced level; strengthen the math and science and technical base; retool laboratories and faculty; and in particular, build on the areas of some of the engineering technologies.

We have in place with the JTPA legislation, Job Training Partnership Act, at least some Federal policies and resources directed toward assisting the economically disadvantaged to obtain training. If we can begin now to focus on the modernization of this training capacity, we think the reauthorization of vocational education legislation is one place to focus, at least in Federal policy, on modernization.

We would shift the currrent Federal role from assisting States to maintain programs to a unique Federal role that assists States to modernize programs. In addition, Senate bills 1194 and 1195 that deal with tax codes would make it possible to extend the kind of credit that employers have been receiving for assisting universities in research and development to vocational and technical programs in the technology areas, particularly in equipping the labs and assisting them in getting qualified faculty.

We feel that those two pieces of legislation provide an additional mechanism. Congressman Miller in the House has introduced a bill that would require States to give a 25-percent match for developing certain high-technology programs. We feel that is a reasonable piece of legislation as well.

The second Federal role that we see is one of making grants available to States to retrain adults. We would place certain conditions on those grants, and they are outlined in the latter part of the testimony.

The third role: We have 25 percent of the youth in this country having difficulty today moving from school to work. They come to us in secondary and post-secondary vocational programs without basic skills. We simply believe there has to be a Federal role to help pay for the extra cost it is going to take to make those individuals productive. They have had difficulty in the past making the transition; with the changes now occurring in the workplace, that transition is going to become even more difficult.

Fourth, we do not know enough about what the new jobs are that are emerging in the workplace. We do not know enough about how jobs are being collapsed. We do not know enough about the new skills and knowledge that are being required in these jobs. If you talk to plant managers, you get one viewpoint; if you talk to futurists, you get another viewpoint.

Federal roles would be to encourage a great deal of decentralized research, to help us begin to sort out what the new job requirements are in the workplace so that we can begin to better design programs to meet those particular needs.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Bottoms follows:]

STATEMENT
OF
GENE BOTTOMS
Executive Director
of the
American Vocational Association

CHAIRMEN WALGREN AND GEPHARDT AND MEMBERS OF THE SUBCOMMITTEE AND THE TASK FORCE:

I am Gene Bottoms, Executive Director of the American Vocational Association (AVA), a professional association of nearly 50,000 educators who work daily in the training of skilled workers, youth and adults, for today's and tomorrow's jobs. I am pleased to be here with you today to discuss the impact which technology is having and will have on the training and retraining of the nation's workforce. I will address myself specifically to the role of vocational institutions in training and retraining the workforce to function in new and emerging occupations as well as in those more traditional occupations that are undergoing significant changes.

Regardless of their institutional setting, comprehensive programs of vocational education have as their role:

1. to work with employers to determine what jobs are/will be in demand, and to deliver the knowledge and skills needed by workers in those jobs;

2. to develop new programs and revise existing programs for new and emerging occupations;

3. to provide new, entry-level workers with the appropriate knowledge and skills needed in their jobs;

4. to retrain the unemployed, dislocated workers; and,

5. to assist employers, particularly those in smaller companies, to upgrade their employees as a result of changing work requirements.

The role is easily defined; and, to the extent that resources allow, vocational institutions are addressing that role and delivering those programs. However, some serious problems exist in carrying out that role - among the foremost of which is program modernization. Simply, our institutions do not have the resources necessary to stay up-to-date.

The application of advanced technology with its new equipment to the workplace is changing the knowledge and skills that workers need. As seriously, it is rendering a portion of the primary mechanism to train these workers - our nation's vocational-technical education programs - obsolete. Curriculum laboratory equipment, and instructors have become out-of-date for the modern workplace and a major effort utilizing the resources of both the public and private sector will be needed to rebuild this important national infra-structure.

Advancing technology did not cause this situation by itself. The cut-back in federal support for vocational education, compounded by tightened state and local budgets, have created a situation where institutions that deliver vocational-technical education in this nation (community colleges, area vocational-technical schools, comprehensive and general high schools) do not have the necessary resources to modernize programs, including instructors, in line with the requirements imposed by expanding technology in the workplace.

The situation presents some startling contrasts. Arthur D. Little reported that companies spent $22 billion in 1982 for automated manufacturing equipment and that figure will increased to $98 billion annually by 1992. However, federal expenditures in real dollars for vocational education have actually declined, and state and local resources have not been able to make up the loss. The seriousness of the problem is apparent across the nation:

- In Pennsylvania, a total of 53 percent of the tools and equipment used in vocational programs is over 10 years old.
- In New Jersey, the shortage of qualified teachers in technical areas such as computer science has meant that people with minimal experience have been employed in some secondary programs - sometimes with few other qualifications than owning a home microcomputer.
- In Oregon, $9,764,000 is estimated as necessary merely to maintain existing equipment in secondary and postsecondary

vocational-technical programs, while $33,146,000 is needed to bring programs up to industry standards.

- The postsecondary area technical school at Staples, Minnesota, recently advertised nationally for a robotics instructor and obtained five applications. With a salary of $30,000, it is difficult to compete with industry.
- The Kansas Community College Association indicates that five to ten million dollars is required to upgrade its vocational programs with state-of-the-art equipment.

A disasterous form of "economizing" is frequently being practiced when no other alternatives seem available. It is often less expensive for institutions to continue offering outdated programs than it is to retool laboratories, staff, and equipment to meet rapidly-changing workplace needs. Consequently, a larger and larger gap is being created between the knowledge and competence required on the job and those actually possessed by individuals.

This gap raises particular concern when it is translated into its effect upon the American economy and the economy's incumbent impact on our nation's people. The U.S. productivity growth rate has lagged behind foreign competition for more than a decade. Harvard economist, James Medoff, calculates that as much as 60 percent of the drop-off in productivity growth may be due to "Labor Market Imbalance" - misfit of people to jobs. It is critical that, as jobs are changed and updated with new technology, workers also receive the training and education they need to respond to these new demands and challenges. In particular, at least some workers need the advanced-level skills necessary to translate the new technologies into productive applications, while all need enough familiarity with them to employ them confortably and effectively. Competent instructors and up-to-date training equipment are essential components to this process.

Providing workers with that array of needed skills - preparing new workers, upgrading existing workers, and retraining dislocated workers - is the clear role of vocational eduation today. However, some serious problems, among the foremost of which is program modernization, exist in carrying out that clear role. In the following four sections, I will address more specifically the problems of institutions in training and retraining the workforce, and I will suggest a federal role for strengthening institutions' capacity. Those sections include:

I. AN OVERVIEW OF VOCATIONAL EDUCATION TODAY

II. THE STRAIN ON VOCATIONAL EDUCATION DUE TO THE NEW TECHNOLOGY AND DECLINE OF FEDERAL SUPPORT;

III. THE NEED TO DEVELOP NEW PROGRAMS AND TO REDESIGN EXISTING PROGRAMS: and,

IV. THE ROLE OF THE FEDERAL GOVERNMENT IN TRAINING AND RETRAINING

I. AN OVERVIEW OF VOCATIONAL EDUCATION TODAY

To grasp the potential capacity of institutions offering vocational education and technical education in the training and retraining of the nation's workforce, it is important to know what that institutional landscape looks like today - its size, diversity and decentralization. This understanding is necessary in order to derive a modern federal role which will help achieve the goals of national defense and international competitiveness.

No aspect of U.S. education is less well understood than vocational education. It is easy to see why. No area of education is more complex, and none has changed as substantially as vocational education has over the past two decades. Consider these facts:

- During the past 20 years the number of Americans participating in vocational education has grown dramatically. In 1965 one American in 37 was enrolled in these programs. By 1979-80 the ratio had risen to one in every 17.2.
- The growth in enrollments has reflected job opportunities (Table 1). Between 1965 and 1980 enrollments in vocational agriculture remained constant, while enrollments in such specialties as trade and industry, office occupations, health

Table 1 Changes in Enrollments by Occuational Categories*

Occupational Category	Enrolled in 1965	Enrolled in 1980
Agriculture	887,000	878.529
Distributive	333,000	961,018
Health	67,000	834,296
Office Occupations	731,000	3,400,057
Technical	226,000	499,305
Trade & Industry	1,088,000	3,215,987

*These figures are on comparable programs

Source: *Vocational and Technical Education Annual Report FY 1965* (Washington, D.C.: *U.S. Department of Health, Education and Welfare.* Office of Education, 1965). *Vocational Education Data System* (VEDS) (Maryland: National Center for *Education Statistics, 1982).*

occupations, and technical programs expanded enormously. However, technical programs only doubled over the fifteen years, representing an area of needed expansion today.

- Institutions offering comprehensive programs of vocational education have nearly tripled. In 1965 some 1,130 institutions offered vocational education. In 1977 (the last year in which a survey was conducted) the number of institutions had grown to more than 3,200.

Yet these indices of growth do not tell the complete story. Program categories within vocational education have also grown, from just 100 to 1965 to more than 400 today.

Vocational education in 1981 served 16.5 million Americans, who represent a cross section of U.S. society in terms of age, race, sex, academic ability, socioeconomic level and goals.

- Slightly more than 10 million vocational education students are 18 years of age or younger and still attending school; another 6.5 million are young or older adults. The average age of vocational students enrolled in postsecondary programs is 29.

- Minority students make up 24% of the total enrollment in vocational education - about 4% more than we would predict from their proportion of the general population.

- Among all students in vocational education programs, 51.6% are female and 48.4% are male.

- Although the mean reading and math scores of high school seniors enrolled in concentrated vocational education programs are significantly lower than those of college-bound seniors, the scores of 65% of the students in vocational education programs are the same as the scores of their college-bound counterparts.

- Of the students enrolled in postsecondary vocational programs, approximately 25% have previously been enrolled in college or other postsecondary educational programs.

More than 19,000 public institutions in the U.S. today offer vocational education programs. Some of these institutions are secondary, and some are postsecondary serving both in-school and out-of-school youth and adults. They are highly decentralized and are administered under a variety of and local governance structures and arrangements. (See Table 2 for a list of the public institutions providing vocational education and the number of institutions in each category.) In addition, several thousand more private vocational schools offer training.

The numbers and kinds of vocational institutions are dramatically different from the way they were twenty years ago. In 1960, approximate-

Table 2: Institutions Offering Vocational Education

Institutional Type	Distinguishing Characteristics	Number of Schools
General High School	-Usually offer 2-3 vocational courses; most typically: business & office, agriculture, industrial arts, consumer & homemaking	10,851
Comprehensive High School	-A general school offering programs in at least six different vocational subjects, but in which the majority of students are not enrolled in programs of vocational education	4,878
Vocational High School	-A specialized secondary school that offers a full-time program of study in both academic and vocational subjects and in which all or a majority of the students are enrolled in vocational education programs	225
Secondary Area Vocational Center	-A shared-time facility that provides instruction in vocational education only to students from throughout a school system, or region. Students attending an area vocational center receive the academic portion of their education program in regular high schools and other institutions. In many states, these institutions serve adults during the day and evening.	1,395
Postsecondary Area Vocational School	-A non-degree gaining institution (or an institution that is not recognized as a collegiate degree by appropriate regional accrediting commission) offering instruction in vocational and techncial education only, and whose educational programs are terminal.	504

Table 2. continued

Institutional Type	Distinguishing Characteristics	Number of Schools
Community Colleges	-A two-year postsecondary degree granting institution which may also award certificates and licenses offering a comprehensive program of instruction in both general and vocational-technical education and offering a transfer program to higher education institutions.	720
Technical Institutions	-A two-year postsecondary degree granting institution offering instruction primarily in vocational and technical education and whose educational programs are primarily directed toward immediate job placement.	162
Specialized Postsecondary Schools	-A specialized postsecondary school usually offering preparation in one occupational area.	308
Four year Institutions Offering two year Programs	-A four-year college of university offering two-year degree programs in vocational or technical education.	185
Skill Centers	-Usually separate institutions specializing in providing vocational education to economically disadvantaged students.	70
	Total Number of institutions	19,298

ly 600 institutions nationwide could be defined as area vocational centers; today over 8,000 institutions are classified as area vocational education centers. (A vocational center is an institution offering at least six vocational programs, including at least four of a laboratory nature.) Institutions that offer the more intensive programs are the area vocational education centers, the technical and community colleges, and the hundred four-year institutions which offer associate degree programs a variety of vocational and technical areas.

Vocational education programs can be classified into two broad categories: general and occupational specific. General vocational education programs are designed to provide a foundation for career decisions, to develop the prerequisite skills to master an occupational area, and to develop the generic skills useful both in work and in everyday life. Approximately ten million individuals are enrolled in such programs.

The occupational specific vocational programs, by contrast, have as their primary focus instruction in content and skills that are necessary for employment in a specific job or occupational area. Approximately six million youth and adults are enrolled in these programs, with approximately three million at the secondary level and another three million at the postsecondary and adult level. These programs can be grouped into four distinct types:

- Occupational cluster programs. These prepare a student for a cluster of occupations, such as agribusiness, construction, the metal trades, or office work. This is the kind of vocational program most commonly offered in comprehensive high schools.

- Occupational specific programs. These are designed to prepare students for employment in a particular occupation, such as computer programming, auto mechanics, electronics, or practical nursing.

- Job-specific programs. These are designed to increase students' potential for employment in a particular, narrowly defined job, such as lathe operator, typist, or front-end alignment specialist.

- Employer-specific programs. These are designed to better prepare participants for a particular job with a particular employer. Participants are generally employed already, and these programs are usually conducted by community colleges or vocational/technical schools. Such programs are likely to increase rapidly in number, because of changing technology in the workplace.

The national vocational education system represents a part of America's infrastructure. Its programs and procedures provide the basis for specialized efforts to respond to particular societal and workplace requirements such as the current needs for advanced-level, technically skilled workers and retrained displaced workers.

The diversity of the institutions which comprise the vocational education enterprise in the United States is evident in the tables shown previously.

Those who usually divide education by levels think they can also divide vocational education that way, but vocational education seldom is categorized that neatly. Many states like Oklahoma have 11th and 12th graders attend their local area vocational education programs where they learn specailized skills with recent high school graduates and returning older workers. In some "secondary" vocational centers, displaced workers take their position along side high school students to acquire job-related skills. What kinds of institutions are these? Secondary? Postsecondary? While not all settings serve these diverse ages, ones which do are likely to become more common in the future.

During the past few years, most states have mounted concentrated compaigns to connect their vocational education programs to the needs of industry. They have designed a variety of strategies to coordinate the resources of the education community, employment service agencies, and economic development agencies in order to train workers in the skills required by public and private employers, including those in defense-related industries.

Over the past few months, AVA has surveyed states, formally and informally, to collect descriptive information on their various approaches to industry/education collaboration in training. The evidence reveals strong commitment and productive results.

Some programs are designed to retrain the unemployed in new and expanding industries, some are customized to a particular industry (locally employer-specific), and other programs aim toward upgrading skills of existing employees to increase productivity and to keep up-to-date with new technology. In certain cases, existing programs are expanded, or a second shift is added in the late afternoon. Other situations have called for the addition of completely new programs, often specially set up for retraining the unemployed. In all instances, however, the amount of money being expended (combined state and federal funds) is extremely limited, and the demand for further training exceeds the resources available.

Some illustrative examples of vocational education's direct efforts with industry include:

New York: Federal vocational education funds have been set aside to meet the short-term training needs of a number of businesses and industries, including many who are defense contractors, at both the secondary and postsecondary (Community college) levels.

Training is being provided by BOCES to the Buffalo Color Corporation (a subsidiary of Allied Chemical) for corsscrafting for maintenance departments and skills training in welding and the sheet metal and construction trades.

At Grumman Aerospace on Long Island, secondary-level power hammer training to conduct prototype airframe parts is being provided with Vocational Education Act funds.

The Corning Community College is providing training to the Shepard-Niles Craine and Hoist Corporation, together with the Kennedy Space Center and the Water Vliet Arsenal, to upgrade draftspersons, designers and machinists - to upgrade the corporation's production, testing and design standards. This joint funding effort is a 30%/70% (corporation/VEA) split.

The Rome Cable Corporation (a subsidiary of Revere Copper) is collaborating with the Mohawk Valley Community College on a project to upgrade maintenance electricians in two specific areas: blueprint-reading and trouble-shooting and repair.

Ohio: The Division of Vocational Education has linked their federal funds with the Ohio Department of Development to provide on-site training to International Rockwell on the B1 Bomber project. The training is geared toward the skills necessary to bring up the production line.

Massachusetts: The Division of Occupational Education, together with high-tech firms in the Boston area, is now retraining unemployed school teachers to become computer programmers.

Tennessee: Public vocational education has combined with the U.S. Navy to conduct several high-tech training projects, such as avionics, for Navy personnel. Totally close to $10 million, these on-site programs utilize Navy facilities and state vocational-technical personnel.

Training is also provided to AVCO (national headquarters in Nashville) for in-plant high-tech skils in air missile production.

While still on the drawing board, Tennessee has plans to provide training to the Air Force Experimental Plant, the Oak Ridge Energy Lab, and the Tennessee Valley Authority. The current obstacle to providing that training, however, is a lack of resources. (See attached article from VocEd, March 1983).

Connecticut: Public vocational education facilities are being provided to both Prat Whitney and Hamilton Standard for the training of machinists. In addition, work-study programs have been arranged wherein students receive skill training in the plants and related classroom training in their schools.

Missouri: State resources are utilized to retrain auto workers to return to new plants for GM, Ford, and Chrysler, as well as to enter new jobs in areas such as robotics. The Department of Vocational Education, working together with the state departments of Commerce and Industrial Development seeks to attract new industry, and is capable of responding to a request from an existing business within one week.

Many other states, such as Mississippi and Oklahoma, have launched similar types of programs, limited only by the resources available for program expansion.

In summary, our vocational education survey showed that most of the states have some form of employer-specific training program tailored to local employer needs and are, in fact, preparing unemployed persons for specific jobs in business and industry. All respondents indicated that such training linked to jobs would be expanded if resources were available. Several thousands more unemployed persons could be served each year through this program. The average training cost for each student in employer-specific programs is in the neighborhood of $800.

Many states such as Missouri have made arrangements to mainstream unemployed persons into open slots in existing programs. A number of states were using both secondary and postsecondary failities for this purpose. The average training cost was roughly $1,000 for each unemployed person per year in these integrated arrangements.

Several states such as New Hampshire, Illinois and Florida, were establishing second shift programs in the late afternoon and evening to prepare unemployed individuals in occupational areas in which local employers felt there would be a future need. The average cost of this kind of program was about $2,000 for each person each year, primarily because resources were needed to add a second shift instructor.

In a number of states, we found efforts to create new programs in the areas of emerging and high technology to prepare the unemployed for high growth occupations. The training costs for the first year was much higher in these programs because many institutions had to secure the instructional equipment needed for such training. However, investing now in the expanding technological areas is likely to have high pay-off later.

Efforts to upgrade existing employees in industry to increase their productivity and/or to help them acquire new skills as the company begins to utilize new technology was common in the states we surveyed. In a few instances, the cost of these programs was shared; however, in most of them, the funds came from state and federal vocational dollars.

In most states, we found a very close working relationship between the Economic Development Agency, the Employment Service, and the Board of Education at both the state and local levels. The private sector was actively involved in a significant way.

As stated earlier, the limitation in expanding these programs rests squarely on the issue of resources. All states surveyed indicated that their existing funds were committed early in the year, while they continue to receive requests for these programs year-round.

The last two decades have seen a great emphasis in building institutional capacity. With these programs and failities in place, the challenge now is to modernize programs so they can serve the important role of preparing competent workers that they have in the past - and to expand the use of this highly decentralized and diversified network of institutions in retraining programs that are directly linked to jobs.

II. THE STRAIN ON VOCATIONAL EDUCATION - DUE TO NEW TECHNOLOGY AND THE DECLINE OF FEDERAL SUPPORT

The nation's programs of vocational education face a number of serious difficulties in keeping programs current with the requirements of the workplace. The new technology that is so radically changing the way work is done in America mandates change in the way programs preparing workers for these occupations are taught. New equipment, curriculum and teacher retraining are all required to bring existing programs in tune with the new technology. Only a very few vocational areas will be untouched by the impact of computers, automation and other technology advances.

To grasp the seriousness of this problem, let us look at one field—the autobody repair industry. The unibody construction of automobiles has rendered obsolete over 35,000 autobody shops around the country. These shops are unable to repair automobiles with this new construction.

As a result, damaged unibody cars must be written off as total wrecks because they cannot be repaired. This greatly increases the drain on automobile insurance companies, who pass their increased costs on to consumers in the form of higher automobile insurance costs.

Vocational education programs could help stop these escalating problems if they could afford to purchase the instruction equipment approved for repairing the unibody car, acquire new instructional materials, and provide their auto body instructors with the 150 hours of instruction required to enable them to acquire the background knowledge and skills they need to teach others these new concepts.

But they do not have the funds to make these changes, and the vicious cycle will continue until they do. Many vocational education programs have difficulty keeping pace with technological advances at present. The problem rests, primarily, in the areas of equipment and staff.

Widespread Inadequacy of Equipment in Vocational Programs

Numerous sources emphasize the fact that equipment serving existing vocational education programs is not current and at the level of industry specifications. Consequently, it is not surprising that programs such as one in Oklahoma have difficulty finding the $3.1 million necessary to develop a numerical machine tool lab which is critically needed.

Dr. Orville Nelson conducted a survey for AVA in the Spring of 1981 to identify the status of equipment in vocational education programs throughout the United States. The survey was particularly designed to identify needs related to keeping equipment current with technology.

The questionaire was distributed to subscribers to AVA's Communications Program for Institutions; thus, the selective nature of the sample probably reflected somewhat better than average programs.

The results indicated that recent trends in business and industry toward the rapid adoption and application of robotics and computers in the design, manufacture, and distribution of products was not reflected in the technology used in vocational programs. Fewer than one-half of the respondents were making some use of computer-assisted design and computer-assisted manufacturing. Only nine percent responded they were making extensive use or had developed new programs related to computer-assisted design.

Laser technology and fiber optics, which are being used in a wide variety of applications in business and industry, were not widely used in vocational and technical programs. More than two-thirds responding reported that they were not including these technologies in their programs.

Upgrading Equipment - An Expensive Proposition

Additional findings from Dr. Nelson's study indicated that the lag between the technology used in vocational programs and that used in business and industry is primarily caused by a lack of adequate funds for the procurement of new equipment. Respondents to the survey estimated that it would cost approximately $375,000 to bring the equipment for their Technical and Trade and Industrial programs up to date. They reported a large proportion of their tools and equipment over ten years old; the trade and industry area indicated that 52.5 percent of its tools and equipment was over ten years in age.

Dr. Nelson concluded his study with these words:

> Vocational education has been criticized for its failure to keep pace with emerging skills and technology. The data from these surveys on equipment needs indicate that vocational education programs have been sufffering from a lack of adequate funds to keep its tools and equipment up-to-date with those used in business and industry. In this area, it is almost impossible for vocational education to plan and provide programs related to new and emerging technologies.

A similar study in Pennsylvania found that almost one-fourth of the tools and equipment in its secondary and postsecondary vocational technical programs were no longer current with the technology used in industry. This study disclosed that over $77 million was needed for updating, $35 million to keep advanced technology tools and equipment already purchased current with the state-of-the-art, $21 million for updating worn-out or obsolete equipment, and $21 million for new, advanced technology planned for 1983-84.

This study concluded with these reflections and cautions:

> Vocational education in the past was able to train millions of students and incumbent workers for both entry- and advanced- level jobs using tools and equipment that were comparable with those used in business and industry. However, with rapid technological advances, increased overhead and current economic conditions, there is some doubt about the continued effectiveness of vocational education.

These conclusions were verified in information gathered on the other side of the nation. Oregon found that it would take $5 million to merely maintain its community college electronics/programs current. $70 thousand to maintain its technical agriculture programs and $383 thousand to make them current in new agricultural technology; $1.3 million to maintain industrial maintenance and mechanics programs and $882 thousand to upgrade them.

These figures are conservative when it is recognized that a computer-assisted design (CAD) system which allows vocational educators to develop the types of competencies and skills used on CAD systems in industry costs at least $300,000 - $400,000. The cost of procuring a robot and developing a laboratory for the study of maintenance and programming of robots requires a minimum outlay of $130,000. In addition, strong electronics and mechanical technology courses would be needed.

It is necessary to clarify at this point what we mean by "modernizing" programs and upgrading equipment. First, we do not mean reconstructing full-scale factories in schools or necessarily placing a robot in every classroom. We recognize this is neither feasible nor necessarily desirable. Students can learn equally well and sometimes better with miniaturized equipment, simulators, or industrial trainers.

Second, we acknowledge that, although few of the total number of jobs of the future will be "high tech," technology will affect almost all jobs. New knowledge, processes and equipment will find its way into the workplae and must necessarily find its way into the classroom.

Local Administrators Cite Effects of Equipment Inadequacies

The actual results of the high costs of up-to-date equipment coupled with limited funds is best described in the words of administrators who testified last year in the vocational education reauthorization hearings before the House Committee on Education and Labor:

> The first concern I have at the local level is that the comprehensive high schools in the state of Illinois have been unable to keep up their capital equipment and facilities; and, because of this, are unable to meet the current needs of business and industry...Our machine shop is utilizing pre-World War II equipment, and our businessmen in the community are saying that students need skills other than that. I could go on and on, with data processing and electronics as examples."

James Mahler, Lockport Township High School - February, 1981

> Various industries have come to us and wanted upgrading in different areas and, basically, we are unable to provide them the upgrading they need on current equipment. When an industry comes to you, they do not want to be upgraded on yesterday's equipment. We are also being faced with that problem when we turn out our students.
>
> Alex Capdeville, Helena Vocational-Technical Center, Montana

> In vocational education, your credibility is only as good as the quality of the graduates you produce, and you have immediate accountability. If that graduate walks in and cannot do the job, your reputation goes. We are out of date in equipment. I have been unable to put any significant dollars in equipment for the last three years. You can imagine this in an age when technology is changing so rapidly. The computer area alone absorbs, in our institution, $300,000 to $400,000 a year to keep current. In our electronic technologies and our machine technologies, we just frankly do not have the money.
>
> Carroll Bennett, Des Moines Area Community College, Iowa

Microcomputers Needs in Vocational Education

At this time, there are indications that vocational education students have limited access to computers. As far as we are able to determine, this access varies widely across states and is closely related to the emphasis that has been put on computer acquisition by the state as a whole. For example, there are few computers in Oregon secondary classrooms and even fewer in community colleges. In 1982, there were approximately 328 microcomputers in the vocational programs of the states' 233 high schools or approximately one and one half per school.

Examination of Oregon community colleges revealed about 125 computers in the 13 schools with most of these heavily concentrated in office administration programs.

When these overall averages are considered with the fact that banks of computers are often found in specialized computer classes, it is apparent that the average vocational education students in other areas have limited access to the use of microcomputers. However, it is widely recognized that computers will become an integral part of all general and technical vocational fields and will become essential tools for solving problems within them.

Programs in Delaware, Oregon, Iowa, and Missouri described the essential nature of computer equipment in their automotive maintenance, agriculture, machinist, electronic-electrical, and automated industrial courses. No longer frills, computer-driven equipment is integral to the jobs for which their students are being prepared. Computers now direct the functioning of pneumatic and hydraulic machine tools, industrial robots, drafting equipment, and laser-directed sensory equipment for farm operators and machinery. In order to successfully use these tools, students must grasp the basic principles of computer operation and then use them in a particular application.

Harvard professor, David Birch points out that most of the new jobs of the future will be in small businesses. These businesses will rely heavily upon the use of computers to run their operations. In all fields, in most settings, computers will become an inseparable part of the workplace, and workers will need to be comfortable using them.

Staff Support Needs In Vocational Education

Serious problems are being encountered by vocational-technical programs as they attempt to hire competent instructors in those occupational areas most impacted by high technology. Repeatedly, programs report vacancies, courses not offered, and compromises made when hiring is finally done since they are unable to fill positions with qualified personnel. For example:

- Six of New Jersey's 20 secondary districts offer what may be called true high technology programs. Of these six districts, five need electronics teachers while seven computer science openings presently exist.
- In Oregon secondary programs, six electrical mechanics and six automated industrial instructors are presently needed.
- Although Iowa community colleges have a requirement of three years work experience beyond the journeyman level, it has been necessary to hire people with less experience in the electronical, tool and die, and automotive and diesel mechanical areas.
- At the Nebraska Indian Community College, there has been an instructor turnover every year in automotive mechanics.

It becomes apparent that these reports are not isolated cases when more comprehensive surveys are examined. The American Association of Colleges and Junior Colleges polled the readership of its association newsletter; 89 percent of the 433 respondents indicated there were shortages or critical shortages in computer science instructors in their programs, while 67 percent reported shortages or critical shortages in electronic technology teachers. In fact, a general shortage of instructors in most technology-related fields was found including the allied health and fields categorized as "high tech."

Dr. Orville Nelson, mentioned earlier, conducted a Vocational Staff Survey for AVA in the Spring of 1982. Of the 283 schools responding, 52 percent reported problems hiring Trade and Industrial, 20 percent agriculture, 25 percent health occupations, and 22 percent technical teachers.

Low Salaries Discourage Qualified Instructors - Programs Hurt

Low salaries were identified in Dr. Nelson's survey as the primary barrier to hiring qualified vocational teachers. Schools are seldom able to offer individuals trained and experienced in technical areas what they would be able to earn in business and industry. Table 3 gives the starting salaries of teachers in selected states and the amount they would earn in various technical positions in the private sector. Even when schools offer special inticements such as higher-than-prescribed

Table 3

Starting Salaries for Teachers
in Selected States

State	K - 12	Community College
Colorado	$13,955	
Iowa		21,000*
Kansas	12,946	13,912
New Hampshire	9,000	
New Jersey	12,000	
Oregon	14,820	14,700

* Three years in related work beyond journey status

Starting Salaries for Employment
in Advanced Technology Positions

Industrial Laser Process Technician	$15,000
Industrial Robot Production Technician	15,000
Bionic-Electronic Technician	21,000
Agricultural Business, Technologies	15,000
Computer Programmers	13,000

The Futurist, June 1982

salaries, moving expenses, and travel expenses to and from school (in the case of the Nebraska Indian Community College), they have difficulty matching the financial benefits of working in business and industry.

Dr. Nelson's survey revealed that the major consequences of failing to employ qualified teachers were 1) reduction in program quality (reported by 59 percent of the institutions), 2) dropping a needed program (24 percent), and 3) failure to develop new program(s) (20 percent).

Furthermore, assistance by business and industry in financing the salaries of vocational teachers was not found to be common. Twelve percent of the schools responding reported they were currently receiving support for teacher salaries with the level typically being 25 percent or less. Three schools indicated business/industry support of 50 or more percent of a teacher's salary.

Joint Investment in Teacher Resources Necessary

Without a doubt, the most important component of successful educational programs are their teachers; yet, the vocational technical programs most critical to our nation's economic well being have serious trouble attracting and holding qualified staff. To say "we are eating our seed corn" accurately portrays the serious nature of the situation which exists in America today as we neglect to invest the resources necessary to supply the teachers needed to train the competent people of the future. Instead, these intructors are pulled into material production, and the fruits of their labors are enjoyed today with little thought of the future.

Declining Federal Support

Obviously these equipment and staff needs — along with the other components of quality vocational education programs — are greater today than at any time in our nation's history. And the role of federal funding in assuring their availability is critical.

Yet the Administration would answer all of these problems by cutting federal funding for vocational education in half and eventually turning all responsibility for vocational education over to the states, local communities and private employers. This proposal stems from some basic misinformation about vocational education funding and a failure to understand the role that federal support has played and must continue to play in addressing national employment priorities.

There are serious fallacies in this reasoning. The most recent data from the National Center for Education shows that the ratio of state and local dollars to federal dollars in 1980-81 had fallen to 7.8 to 1, down from a peak of 10.4 to 1 in 1977-78. In 1980-81 constant dollares, nonfederal dollars actually decreased by 12 percent between 1977-78 and 1980-81. For several years many states have not allowed postsecondary institutions to expand their enrollments, and funds have been reduced for new programs. As a result, we lack sufficient capacity today, especially in the engineering technolgies.

When we look more specifically at areas of national priorities, federal funding is much more significant. In 1980-81, the state/federal match is as follows: "Program Improvement", 2.02 to 1; "Special Programs for the Disadvantaged", .48 to 1; "Programs for the Handicapped", 2.3 to 1; "Programs for the Disadvantaged", 2.9 to 1, and "Limited English Proficiency", 2.8 to 1.

These figures clearly show that federal funding is essential to achieve critical national priorities.

Overall, the decline in the national investment in vocational education over the past decade has been significant. Federal funding per student has dropped from $81 in 1972 to $45 in 1980 in constant 1980 dollars while the state and local investment also dropped from $384 per student to $374 per student for an overall drop of $46 per student.

Further, these federal cutbacks have sent a signal that skill training for the labor force is not an important issue, and the result is mounting evidence of the decline in state and local expenditures for vocational programs. The administration's contention that the states and locals will "pick up" the cost of training is being proved erroneous, especially in those states hardest hit by the recession and in poorer regions.

While the data is not yet in for all states for 1982-82, the evidence seems to indicate, in general, that those states in the worst economic condition are continuing to decrease their state and local expenditures for vocational education—thus, deepening their eroding position and furthering their deficits, making it harder to come back to economic stability and growth. Even the growth of local vocational education facilities and equipment to train and retrain adults after school has suffered major cutbacks as school boards seek to balance budgets.

The chart on the following page uses the Vocational Education Data System to compare expenditures (state/local and federal) for vocational education between 1980-81 and 1981-82. Note that these figures are unedited, and they include carry-overs and unliquidated obligations. Most importantly, these figures are not adjusted for inflation—they do not reflect purchasing power.

Most importantly, these figures illustrate clearly the continuation of the downward trend which began in the 70's—the weakening capacity of our vocational training system to prepare skilled people who can compete in the labor market. Without question, no state has shown increases (10% or more) that would be required to keep programs at the pace of double-digit inflation.

This decline in support of vocational education has serious and startling implications for the nation's economy.

COMPARISON OF EXPENDITURES FOR VOCATIONAL EDUCATION BETWEEN 1980-81 AND 1981-82

	1981			1982					
STATE	TOTAL	NON-FEDERAL	FEDERAL	TOTAL	NON-FEDERAL	FEDERAL	[DECREASE]/INCREASE IN TOTAL	[DECREASE]/ INCREASE IN NON FEDERAL	[DECREASE] IN FEDERAL
Arizona	55,038	46,069	8,969	49,417	42,156	7,261	[5,621]	[3,913]	[1,708]
Arkansas	46,060	39,021	7,039	26,479	22,452	4,026	[19,581]	[16,569]	[3,013]
Connecticut	76,441	66,721	9,720	81,371	74,833	6,538	4,930	8,112	[3,182]
Idaho	20,371	16,965	3,406	20,829	17,998	2,831	458	1,033	[575]
Michigan	292,575	253,242	39,332	265,592	241,899	23,743	[28,983]	[11,393]	[15,589]
Nebraska	39,284	33,723	5,561	35,723	31,907	3,816	[3,561]	[1,186]	[1,745]
New Hampshire	13,904	10,067	3,837	13,335	10,034	3,302	[569]	33	[535]
North Dakota	18,732	15,995	2,737	19,919	18,180	1,739	1,187	2,185	[998]
Oregon	61,357	53,639	7,717	59,336	53,054	6,282	[2,021]	[585]	[1,435]
South Dakota	12,804	10,541	2,262	11,277	10,225	1,052	[1,527]	[316]	[1,210]
Tennessee	129,569	114,625	14,944	113,744	104,880	8,864	[15,825]	[9,745]	[6,080]
Wisconsin	332,799	305,552	27,276	212,072	196,327	15,744	[109,225]	[109,225]	[11,532]

(in millions)

III. THE NEED TO DEVELOP NEW PROGRAMS AND TO REDESIGN EXISTING PROGRAMS

In this section, we will point out those occupational areas for which shortages of skilled workers already exist and will most likely exist - thus creating a demand for new and revised training programs. We will also illustrate the impact which these technologies will have on vocational programs - especially in terms of the knowledge and skills required of workers - in the traditional occupational clusters of: Trade and Industry, Health, Agriculture, Marketing and Distribution Occupations, and Business and Office Occupations.

Areas in Need of Development and/or Expansion

After a thorough review of a range of sources of occupational outlook data (a partial list of citations appers at the end of this section), as well as vocational program enrollment data, we can point with ample justification to a list of program occupational program offerings which need to be expanded - programs which lack the capacity to prepare advanced-level workers in the areas which will represent many hundreds of thousands of jobs. Those growing occupational fields for which we must expand current program capacity include, but are certainly not limited to:

- micro-electronics technician
- automated manufacturing equipment technician and mechanics
- energy conservation and use technician

- laser/electro-optics technician
- instrumentation and control technician
- tool and die maker
- heavy equipment mechanic
- aircraft mechanic
- bio-medical electronics technician
- hazardous waste management technician
- data processing maching mechanics

While not prepared at this time to indicate the precise number of exactly where these programs ought to be expanded, we do know that these represent at least some occupational areas for which program training and retraining capacity is currently inadequate. Also, we can be sure that the expansion of these program offerings will require significant dollars, these programs are not cheap.

A number of states have already begun to develop new curricula and delivery systems for high technology training programs. The following are brief descriptions of two such examples:

The Telecommunications Technician Training Program, Skyline College, San Bruno, CA

The program is being collaboratively designed and funded by the San Mateo County Community College District and many national companies involved with telecommunications, specifically voice and data transmission, using telephone, radio, microwave and satellite technology. Companies currently involved in the Consortium include American Satellite Company, Crocker Bank, MCI Communications, Pacific Telephone Company, Rolm Corporation, and SP Communications. In addition to hours of planning time, these companies are sharing resources with the District, incuding money, technical personnel, equipment, and facilities. Together the companies and the District have planned a two-tiered training program for telecommunications technicians to be implemented locally at Skyline College and at other industry and education sites nationally. The first tier of the program includes training generic to the industry to prepare a student for an entry-level technician's job. The second tier includes several optional advanced skills modules which are job or equipment specific and can be used for technical employee upgrade and advance entry-level skills. The curriculum is being developed by industry subject matter experts and placed on a computer-assisted, computer-managed videotape interactive delivery system. This system was selected by the Consortium to insure the transportability of the curriculum to other sites and to enable students to schedule themselves and move rapidly into the job market after completing each segment of the curriculum with demonstrated competency. The Consortium has contracted with experts in instructional design and computer interactive delivery to design and produce the curriculum and software. The consultants are working with industry technical experts to identify existing materials, especially videotape, appropriate for this subject matter. The final product will be available to community colleges and industry sites nationwide.

The Laser/Electro-Optics Technology (LEOT) Program, Albuquerque Voctional Technical Institute (T-VI), Albuquerque, N.M.

The purpose of the LEOT Program is to train persons who can assist in the construction, test, operation, maintenance, and repair of lasers and associated systems.

Laser/Electro-Optics Technicians must be prepared to work in a wide variety of jobs and conditions. Program objectives are determined so as to provide as broad a base for training as possible.

The objectives of the LEOT Program at the Albuquerque T-VI are:

1. Each student shall perform experiments, troubleshoot circuits, and demonstrate an understanding of direct, current and alternating current circuit theory.
2. Each student shall perform experiments, troubleshoot circuits, and demonstrate an understanding of combinational and sequential digital logic circuits.

3. Each student shall demonstrate their knowledge of programming by writing and executing machine language programs using a microprocessor based microcomputer, and by writing and executing programs written using BASIC programming language.

4. Each student shall demonstrate knowledge of laser theory; and, they shall safely use the laser and other light sources to perform experiments to demonstrate principles of geometric and wave optics, and to demonstrate the uses and limitations of the various optical components.

5. Each student shall demonstrate a knowledge of the measurement techniques used to determine the characteristics of various light sources. These could include incandescent lamps, gas discharge lamps, semi-conductors, as well as several types of lasers.

6. Each student shall operate, clean, modify, and measure the output characteristics of several types of lasers. These include low current-high voltage gas lasers, semiconductor lasers, ion gas lasers, solid state lasers, flowing gas CO_2 and nitrogen-dye lasers.

7. Each student shall demonstrate knowledge and skill with fiber optics by making measurements of fiber transmission characteristics, and by making low-loss connections between fibers.

8. Each student will explain the principles of operation, and correctly install and use various devices for modulating, Q-switching, frequency doubling, expanding, collumating, and analyzing the output of a laser.

9. Each student shall keep notes of all experiments. These notes shall include equipment lists, diagrams, graphs, data tables, and sufficient descriptions so that the experiments may be repeated without references to other sources.

Programs in Need of Revision

Second, we can point to a series of programs which require significant revision (as opposed to expansion). After reviewing the current fields, in our best judgement, the following vocational program areas need to be updated as a result of technological change in the workplace:

- business and office programs
- automotive mechanics
- electronics
- auto body and fender repair
- welding
- drafting
- metal trades
- electrical and electronic equipment repair
- agriculture mechanics
- marketing and distribution

Here again, this list does not necessarily represent all vocational technical programs in need for revision, but it does provide an illustrative range of those programs in need of change (curricula, equipment, staff knowledge, and skills).

The nature of these revisions will vary according to the technologies and the occupational areas - for example, the shift in metal trades to an electronics emphasis, and the move in business and office occupations to computers and word processors. Other examples include the teaching of electronics to auto mechanics students and new science of auto unibody repair (the mechanics of unibody collision damage repair). Appendix A contains materials developed by Conserva, Inc., Raleigh, N.C., which illustrate in greater detail the impact which the new technologies will have on vocational programs and the nature of revision required.

At this time, vocational education programs prepare millions of people in occupational areas where millions of jobs will be - especially between 1983 and 1990. However, due to the changing job requirements of the workplace, a number of vocational programs will require either a significant degree of expansion, and essentially all vocational programs will require at least some degree of revision. All of this will take close scrutiny and comprehensive analyses - especially in terms of the precise skills required and the most effective delivery approaches to developing those skills, especially advanced level skills - now in the greatest demand - requiring broad technical knowledge.

The Shortage of Advanced-level Skilled Workers

Those redesigned vocational programs, as previously described, will have to directly reflect the precise skills involved within those new and emerging occupations. Clearly, more advanced-level skills, built on a broad scientific and technical knowledge base, are/will be required of workers. A quick scan of the want-ads in major newspapers illustrates the degree to which employers are already delineating the particular, highly advanced technical skills which they demand of workers - skills which, in most cases, require technical training. One vivid example is that of the transportation industry - an area of great national need which has been heavily affected by technology.

In this concern, we refer to not the operation but rather to the manufacture, maintenance and repair of the vehicles and supporting equipment that make up our nation's transportation system. The intense need in this area for skilled, competent technicians was emphasized in the near disaster involving missing valves in an Eastern Airlines jet. Although less dramatic, we live daily with the consequences of technology applied to production in an area of which insufficient numbers of skilled mechanics are available.

John Naisbitt's Megatrends relates the problems plaguing the mass transit systems of several large American cities:

> Both Houston, Texas, and Baltimore, Maryland, have plans to renovate old buses, at considerable expense, because the new "advance design buses" manufactured by both General Motors and Grumman's Flexible Industries (the only type currently available in the United Stated) have proved too difficult and expensive to maintain. In Connecticut electrical fires have started in the engine boxes of five Grumman Flexible's buses. Miami's new air conditioned buses broke down when the air conditioning was turned on. Houston has 150 of the General Motors buses, which have lifts for the handicapped, wide seating, air conditioning, and windows that don't open. The city found itself in a crisis situtation last summer when the air conditioning on dozens of the new buses broke down, making them unusable. Authorities solved the problem by removing the windows in forty of the buses, a short-term solution at best.

The unibody construction of automobiles has rendered obsolete over 35,000 autobody shops and their mechanics around the country. These shops and mechanics are unable to repair automobiles with this new construction. As a result, damaged unibody cars must be written off as total wrecks because they cannot be repaired. This greatly increases the drain on automobile insurance companies, who pass their increased costs onto consumers in the form of higher automobile insurance costs.

State automobile inspections are now conducted almost entirely with computerized testing equipment. Sophisticated hydraulic, electronic, and pneumonic equipment have found their way into autobody shops and are, therefore, needed in training programs to prepare the workers who will use them. "Dedicated benches," micro-electronic monitors, and "tape operated mills" sit beside wrenches, standard welders and electrical grinders.

Clearly, meeting the national demand for advanced level skilled workers requires that we begin to look at a new type of specialized intensive, long-term education program that currently does not exist in America. The absence of such a program does make a difference in a world market. That fact is graphically illustrated by looking at how American students fare in competition with students from all over the world in the International Skills Olympics. The average score for the United States in all trades entered in the most recent competition was lower than scores for either the European or Asian nations. (See the following two charts.)

These data clearly illustrate this nation's inattention to preparing advanced-level skilled workers who can translate state-of-the-art technology into new products that could aid our competitive position in the international marketplace. Clearly, one of the roles for federal support of vocational education has to be encourage states and local communities to look for creative approaches to preparing several thousand graduates with a high level of technical skills each year. These students should be able to compete successfully with graduates of programs anywhere else in the world. For that to occur, some programs will have to become more intensive, including a strengthened math and science base and a broad spectrum of experiences in the private sector. Due to this increased intensity, programs will also have to be increased over time - in some cases from four to six years.

INTERNATIONAL SKILL OLYMPICS
SEVEN-YEAR AVERAGES

Country	Average Performance in All International Skill Competitions*
Belgium	55.8
Ireland	57.2
Netherlands	61.7
Portugal	53.8
Spain	60.8
United Kingdom	58.3
Austria	67.82
France	63.50
Germany	66.3
Japan	73.8
Korea	78.2
Lichtenstein	69.0
Switzerland	68.5
Taiwan	68.3
United States	53.6

*Since 1975

INTERNATIONAL SKILL OLYMPICS

Countries	Auto Mechanics	Precision Machining	Welding	Construction Trades	Electronics	Average Score On All Trades Entered
Central European	77.8	61.7	61.3	71.67	69.65	67.02
United Kingdom and Other European	76.41	54.6	57.9	60.6	59.08	57.9
Asian	79.93	81.93	76.4	71.55	81.03	73.43
United States	80.2	46.1	53.4	53.13	68.5	53.6

A major reason for this dangerous situation in which we find ourselves is the lack of focus, as a nation, on these skills which industry now requires of workers. We have no national policy which emphasizes the need to develop advanced-level technical workers who have the sets of skills described above. Currently, our policies direct resources to the lower and upper ends of the educational spectrum.

Nevertheless, we can point to some exemplary programs with creative approaches to developing advanced-level skilled workers. The following three examples illustrate how programs are intensified in skill level (via collaboration with employers), and extended, over time, from the secondary to the postsecondary level.

The Technical Scholars Program, Greenville Technical College, Greenville, S.C.

This program recruits top high school students for demanding technical careers in the Greenville area. This three-year cooperative program, sponsored by employers, is built around a school-in-the-morning, business-in-the-afternoon format. The sponsoring company buys books and pays tuition for its Tech Scholars and gives them 20 hours of paid work per week. In its first three years, the program has grown from the original 10 to 20 company sponsors, offering five curriculum options - from computers to office management - to over 100 students. Greenville Tech now screens over 500 candidates a year for the Technical

Scholar Program. In the spring of 1982 the first technical scholars graduated, and all were hired full-time by their sponsoring companies.

The Pre-Tech Program, Richmond County Board of Education, Augusta, GA

This example is the "2 + 2" approach, an articulated program between the secondary and postsecondary levels, represents a curriculum path designed to prepare students for entry into a four-year program leading to a Bachelor's degree in engineering or into a two-year high technology program.

Typical graduates from a pre-tech school are required to complete related training in units including language arts, math, science, social studies, as well as electives in drafting, computers, electronics and electromechanical. The postsecondary programs which follow focus on technical specialization in the chose occupation.

Broader Technical Knowledge and Skills Required of Workers - Via Training Programs

Without question, the traditionally narrow "crafts" approach to training is not adequate in many areas in today's workplace since "high technology" refers to the most advanced machines, systems, and devices in the modern world. Automated, instrumented and computerized, these complex systems and devices require special competencies for production, testing, installation and maintenance. To perform such functions, technical workers need to understand systems - combinations of electronics, mechanical, fluidic, pneumatic, optical, and thermal applications.

One example of a program attempting to move from the old, craft approach to the broader base is at the Cleveland Community College. In an attempt to revamp their engineering technologies programs, the college is receiving assistance froman industry-based advisory committee and an outside consultant. The objective is to create an integrated core curriculum to be used as the base of all engineering technologies - to create well-equipped technicians who can install, maintain, and repair sophisticated equipment in settings such as power plants and manufacturing firms. A major curriculum development and faculty retraining effort is underway. Non-essential academic courses are being dropped as a tight, seven quarter (over two years) curriculum design is composed of 65-75% common core courses and 25-35% specialty courses.

Many high-technology occupations have a universal requirement for an individual with ability to transfer knowledge from one set of tools and materials to another set of tools and materials. Often this transfer includes changes in energy forms. The skills of high technology are acquired, therefore, by developing an understanding of the physical sciences and their applications, rather than by becoming proficient in a trade or a craft or through academic study. This requirement introduces new dimensions in the instructional program.

In metals, especially, the new field of "non-destructive testing" has brought the source of materials technology to the forefront. Increasingly in casting and forging, the need is to test the integrity of components - to detect defects and flaws within via ultrasonics, x-rays, etc. As a result, the demand for the relatively new skilled worker called "materials engineer" is rising. (Power Magazine, June 1983, p. 9)

Postsecondary education programs for technicians prepared in this way have been developed with a "systems" orientation and a broad base of physics. Among the most successful are two-year, associate degree level, programs that use the Unified Technical Concepts instructional model developed by the Center for Occupational Research and Development. With this system of instruction, the key elements of technology - electricity, mechanics, fluidics, and thermal principles - are presented as analogous rather than as isolated, independent phenomena. Extensive use is made of industrial applications to teach these basic principles in school laboratories. The secondary school programs need to include an introduction to a similar system of instruction.

Georgia is an example of a state utilizing the unified physics concept - requiring all engineering technologies students at three postsecondary schools to take this three quarters sequence. Further, Georgia has begun an entire statewide process to upgrade its vocational-technical schools on a number of fronts: (1) to completely revamp their electronics programs; (2) to upgrade faculty and equipment; (3) to add the physics component; and, (4) to establish a foundation through which to obtain private sector support for this entire revamping effort. In fact, this initiative began when employers pointed out how Georgia had allowed its vocational-technical system, once on the cutting edge of modernization, to erode.

We know, too, that as a base for these advanced-level skills, programs must strengthen the math, science, and literacy competencies of students - in direct relation to broad occupational goals. Part of today's problem stems from the fact that programs have not produced the level of technically-skilled workers who understand the principles of science and math underlying a technology - the applied technology principles undergiring each occupational area.

The area vocational centers in Ohio have done an excellent job in teaching math and science in direct relation to occupational skill area subjects. Building this expanded math and science base has required students to take more hours of instruction.

Also at the heart of virtually all occupations is/will be the computer. Vocational programs will need to teach students to use software in an array of applications from keeping inventories to estimating auto repair costs. Computers will be used in all areas - from health to agriculture to business and office - and they must be incorporated into all training and retraining programs.

Another core of most programs is/will be electronics, especially in the expanded use of micro-processor. In order to install, maintain, and repair sophisticated equipment in occupational areas such as transportation, manufacturing, and business/office workers, will have to understand the electronic core of most mechnical devices.

Further, as a result of "flexible manufacturing" manufacturers' move toward the production of fewer products, but a greater variety of products), workers must be able to tear down and put up an array of production processes. Closely related, workers must understand the connection of their own activities to other parts of the plant's operation - understanding the relation of their particular part to the whole system. Without these types of knowledge and skills, incidences such as that of Three-Mile Island will reoccur.

The final component is/will be tht of basic human skills - workers' abilities to identify and solve problems, to think and listen, to innovate by predicting situtations and making some judgements/decisions. Programs must develop workers' adaptive as well as leadership skills - especially in team situations. (These were comments heard from employers, over and over again, at the AVA/CORD High Technology Workshops.)

How Programs Can Be/Are Being Expanded and Redesigned

The changing requirements of the workplace virtually mandate changes in the ways we develop the content as well as the delivery of vocational-technical programs.

In referring to the Resource Guide developed for the AVA/CORD High Technology Workshop Series,* we can first point to a process which can be used to evaluate and implement changes in secondary vocational-technical programs due to the impact of high technology. Using available resources data covering changes in the field and the information gathered on existing and future jobs, an assessment of the occupational changes brought about by high technology developments can be made. This information can be separated out in two forms:

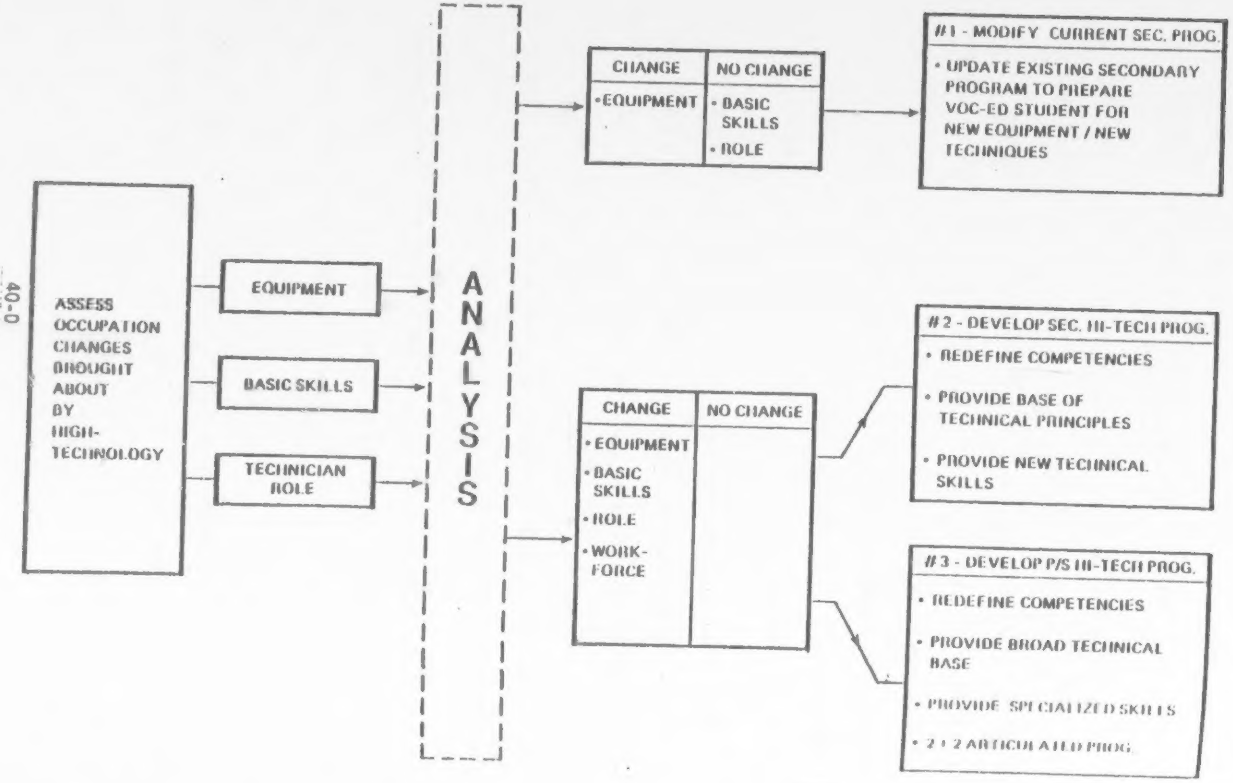
1. Equipment changes; and,
2. Workforce changes.

Equipment changes will indicate immediately the extent to which high technology has effected the program in question. Workforce changes will determine whether there will be more or fewer workers and/or whether the roles and responsibilities of workers will be altered. The diagram on the next page describes that process for evaluating and implementing changes.

*Recently, AVA conducted a series of High Technology workshops together with the Center of Occupational Research and Development (CORD) of Waco, Texas. The workshops were designed to raise awareness of the implications of technology in vocational-technical school programs and to introduce some guidelines for rethinking curriculum in light of these implications. At the heart of the workshop is a 185 page guide, already placed in the hands of more than 1,800 educators nationwide.

ROLE OF SECONDARY SCHOOLS

IN HIGH-TECH EDUCATION


ASSESS OCCUPATION CHANGES BROUGHT ABOUT BY HIGH-TECHNOLOGY
EQUIPMENT
BASIC SKILLS
TECHNICIAN ROLE
ANALYSIS
CHANGE
• EQUIPMENT
NO CHANGE
• BASIC SKILLS
• ROLE
#1 - MODIFY CURRENT SEC. PROG.
• UPDATE EXISTING SECONDARY PROGRAM TO PREPARE VOC-ED STUDENT FOR NEW EQUIPMENT / NEW TECHNIQUES
CHANGE
• EQUIPMENT
• BASIC SKILLS
• ROLE
• WORK-FORCE
NO CHANGE
#2 - DEVELOP SEC. HI-TECH PROG.
• REDEFINE COMPETENCIES
• PROVIDE BASE OF TECHNICAL PRINCIPLES
• PROVIDE NEW TECHNICAL SKILLS
#3 - DEVELOP P/S HI-TECH PROG.
• REDEFINE COMPETENCIES
• PROVIDE BROAD TECHNICAL BASE
• PROVIDE SPECIALIZED SKILLS
• 2 + 2 ARTICULATED PROG.

Also, from our Resource Guide, we can point to a proposed curriculum structure - as shown in the two charts which follow.

A broad-based, systems-oriented curriculum ought to be made up of two main parts: a common core and a specialty sequence. The common core, by far the largest part, would be comprised of basic skills and a technical core. Basic skills would include units in math, (algebra, trigonometry, analytic geometry); and the physical sciences; human relations and the socioeconomic factors that affect most jobs; technical communications (in speech and writing); and computer literacy (including typing or keyboarding).

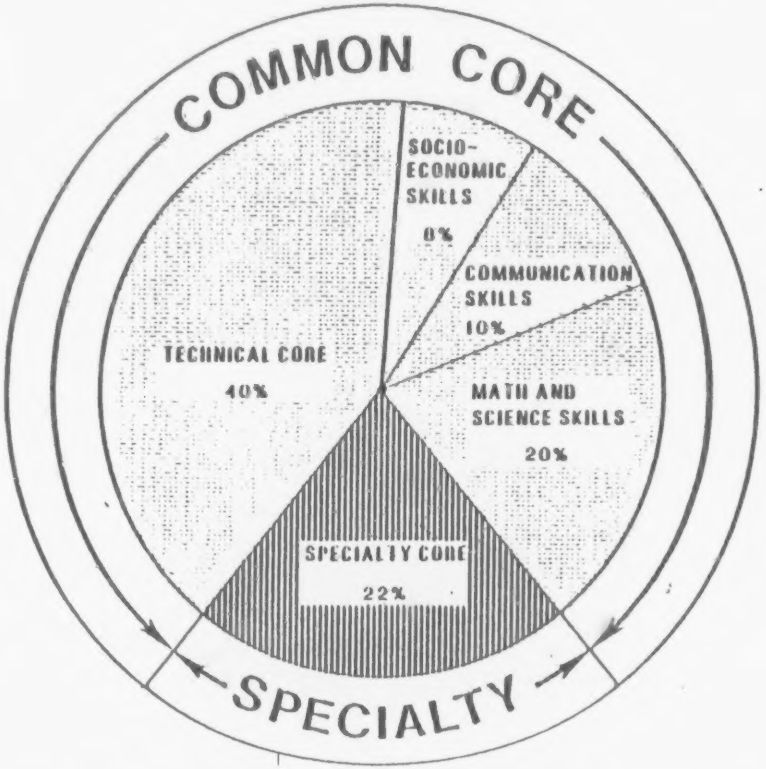
The second part of the common core is a selection of technical subjects: electrical and electronic devices, mechanical devices, electromechanical devices, fluid devices, heating and cooling devices, optical devices, and microcomputers. It is this part which provides the technician with the broad-based technical core. Course descriptions of the technical core subjects appear as Appendix B.

Together, the basic skills courses and the technical courses comprise the common core, which ensure that the technician has the broad knowledge base and flexibility needed to function efficiently in high-technology occupations.

The specialty sequence of the curriculum would consist of five or six courses. These courses would be system-specific and would ensure

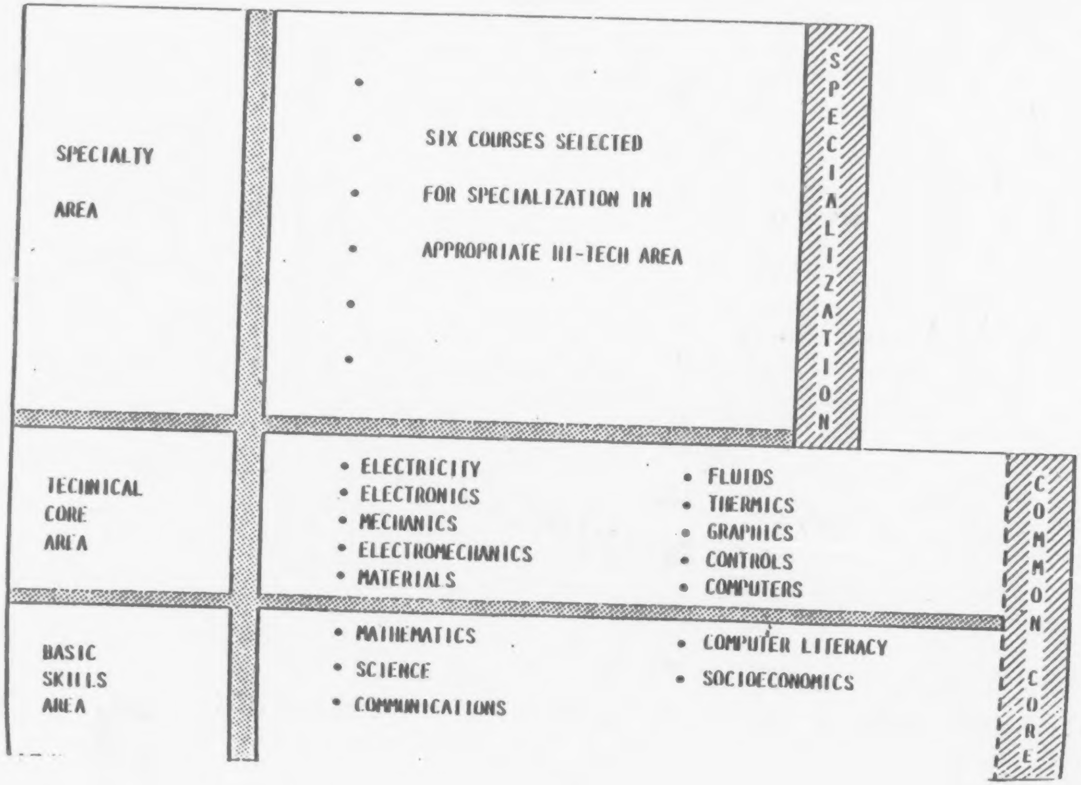
PROPOSED HIGH TECHNOLOGY CURRICULUM STRUCTURE

DISTRIBUTION BY COURSES



PROPOSED HIGH TECHNOLOGY CURRICULUM STRUCTURE

GENERAL PHILOSOPHY



SPECIALTY AREA

-
- SIX COURSES SELECTED
- FOR SPECIALIZATION IN
- APPROPRIATE HI-TECH AREA
-
-

SPECIALIZATION

TECHNICAL CORE AREA

- ELECTRICITY
- ELECTRONICS
- MECHANICS
- ELECTROMECHANICS
- MATERIALS
- FLUIDS
- THERMICS
- GRAPHICS
- CONTROLS
- COMPUTERS

BASIC SKILLS AREA

- MATHEMATICS
- SCIENCE
- COMMUNICATIONS
- COMPUTER LITERACY
- SOCIOECONOMICS

COMMON CORE

knowledge base and flexibility needed to function efficiently in high-technology occupations.

The specialty sequence of the curriculum would consist of five or six courses. These courses would be system-specific and would ensure that the technician attains a certain level of expertise in whatever technology he or she chooses as a specialty - robotics, computer, or laser systems, for example. Some typical high-technology programs and selected of their proposed curricula appear as Appendix C. It should be readily apparent that the basic subject areas and the technical core courses - the common core - are the same for each specialty area. Only the specialty courses change.

In the next, final section, we suggest some policy recommendations which would provide a catalytic role for the federal government - to set the nation on the right course in order to ensure the training and retraining, so desperately needed, of technologically skilled workers. The timing could be no more perfect, given the upcoming reauthorization of the Vocational Education Act of 1976, anticipated for this summer or fall.

Sources of Data on Worker Shortages

"Report on Participation in the International Skill Olympics," National Vocational Industrial Clubs of America (VICA)

"Churning and Mismatch in U.S. Labor Markets," James L. Medoff, Harvard University, April 1983.

"Growth Industries of the Future," Newsweek, October 18, 1982

"Largest Numbers of New Jobs," Monthly Labor Review

"Robots and Computers Will Affect Workers in Both Factories and Offices," Carnegie-Mellon University

Megatrends: Ten New Directions Transforming Our Lives, John Naisbitt, New York: Warner Books, 1982.

"Regional Forecasts of Industrial Base Manpower Demand, 1981 to 1987," U.S. Department of Defense, Ralph M. Doggett, March 1983

"Defense Economic Impact Modeling System," U.S. Department of Defense,

Occupational Outlook Quarterly - Three paths to the Future: Occupational Projections, 1980-1990, U.S. Department of Labor, Winter 1981

"Careers With a Future: Where the Jobs Will be in the 1990s," The Futurist, June 1982

"Attitudes Toward the Skilled Trades: Employment Issues in the Precision Metalworking Industry," Sentry Insurance, November 1982

"Jobs: Putting America Back to Work," Newsweek, October 18, 1982

IV. THE ROLE OF THE FEDERAL GOVERNMENT IN TRAINING AND RETRAINING

Traditionally, the federal role in vocational education has been to assist the most economically disadvantaged to obtain training and retraining. Increasingly, however, additional roles, critical to the achievement of national economic, defense and social goals, have evolved. Among those roles are:

1. to assist states to modernize their vocational education training capacity;
2. to assist states, through grants, to utilize their vocational-technical programs in the retraining of adults;
3. to assist states to provide the extra efforts and services required to prepare special population youth for employment; and,
4. to support research and development efforts designed to sort out the changing demands of the workplace.

In this final section, we recommend ways in which the federal government could most effectively carry out each of these roles.

Modernizing the Nation's Training Capacity

A strong federal role in modernization is crucial if this nation's diversified, diffused, and decentralized training capacity is to respond in a cohesive manner to the changing requirements of the workplace. A comprehensive modernization emphasis would support much-needed new program development: revising existing curricula, upgrading instructional equipment, strengthening math, science, and technical knowledge bases, and achieving closer coordination/cooperation with employers - all to prepare advanced-level skilled and technical workers.

Another aspect of modernization is the projection that 66% of the new technical and advanced-level jobs will be filled by women. This phenomenon will result in a significant increase in the number of women who enroll in non-traditional occupational training programs. The federal government will have to take a leadership role in meeting the special needs of this population - an important aspect of modernization.

The reauthorization of the Vocational Education ACt of 1976 (VEA), anticipated during the next few months, provides one means of redirecting federal support toward modernization of basic vocational education programs - as opposed to the current use of dollars for simply maintaining programs. Further, Senate Bills 1194 and 1195 (High Technology Research and Education Development) are examples of policy proposals to utilize tax codes to encourage private employers' contributions of state-of-the-art technical equipment and faculty supplements - to help modernize and improve local vocational education programs. Somewhat similarly, a bill to encourage private sector contributions has been introduced by Representative George Miller (D-Calif.) - providing state incentive grants, which require 25% of the funds to come from the private sector, to mount advanced-level, high technology programs.

Federal Grants to States for Training and Retraining Adults

Federal grants should be made available to states for the retraining and upgrading of adults on the conditions that: (a) states would develop, if they do not already have in place, quick-start training programs designed to deliver customized training to specific employers who make available expanding job opportunities; (b) states would actively seek to enroll, during the first fifteen weeks of unemployment, those unemployed workers who are least likely to find employment; and, (c) states develop a close working relationship among employment service agencies, economic development agencies, and vocational education institutions - again, for the purpose of enrolling the unemployed into programs which will most likely lead to employment.

A grant program to states would be economical in that existing institutions and programs would be utilized - enabling them to expand their capacity for serving adults.

The types of programs to be encouraged would be both customized training for a particular industry or industries and programs aimed toward ugrading skills of existing employees to increase productivity and to keep up-to-date with new technology. Strategies to implement these program types should include expansion of programs by adding a "second shift" late in the afternoon, the addition of completely new programs, and the "mainstreaming" of individuals into open slots with both secondary and postsecondary programs.

An effective approach to assist states in adult retraining would be to create an adult retraining title within a reauthorization vocational education law. This would enable states to respond to the growing training needs resulting from economic development, reindustrialization, and worker displacement. Some of the special programs envisioned under this authorization would include:

(1) Short-term upgrading, updating, and retraining to enable adults to cope with progress as work requirements change.

(2) In-plant and/or institutional training tailored to the need of an industry or group of small industries with common needs, including those caused by changing technology and work requirements.

(3) Quick-start, customized training for workers for hard-to-fill jobs in new and expanding industries.

(4) Entrepreneurship training.

(5) Linkages between vocational education and training and private sector personnel needs.

(6) Cooperative training projects with the private sector and economic development agencies, including institutional or in-plant seminars, to improve productivity.

(7) Skills training and retraining in cooperation with other tax-supported and private sector groups.

Such an emphasis in the new vocational education legislation would encourage states, on an ongoing basis, to bring to bear their vocational education capacity in cooperation with employers in assisting adults to retrain and upgrade their skills in order to obtain or maintain employment.

Another avenue through which to assist states in adult retraining for jobs that are hard-to-fill and that are crucial to national defense and economic growth would be the passage of H.R. 2782 (Defense Industrial Base Revitalization Act) which has been marked-up by the House Banking Committee. This bill provides grant to states for three years, to train individuals - especially dislocated workers - in skills for jobs in critical, defense-related areas.

Grants to States to Improve the Employment Prospects of In-School and Out-of-School Youth with Special Needs

The impact of advanced technology on the workplace will make it only more difficult for many youth to obtain employment - particularly those youth with special needs. Typically, these students enter vocational programs without the basic, prerequisite skills for acquiring the technical skills necessary to enter and progress in a job. Teaching both basic skills and job skills to special needs youth - with the same level of resources available for regular students - is virtually impossible. In essence, the school day, as well as the school year, must be expanded in order to provide both sets of required skills.

Through elementary and secondary education legislation, a federal role has been pursued. Federal funds support the costs of extra services and effort required to teach disadvantaged youth. The extension of such a role to such students enrolled in vocational-technical programs would result in raising their productive capacity and employment prospects.

We recommend that the new vocational education legislation create a separate authorization for youth with special needs. Funds allocated under this title would be used to provide special assistance and services to youth with special needs. Emphasis will be on increasing their access to vocational education, raising the probability of successful program completion, assisting in transition from school to employment, and helping them adjust to the world of work. Special needs youth include members of minority groups, persons who suffer from economic or educational disadvantage, persons with handicaps, non-English speaking students, and male and female students who are enrolled in programs that have been non-traditional for their sex.

Such an authorization in new vocational education legislation would create a compensatory focus through which the federal government would aid the states to assist local communities and institutions to provide the special assistance and extra effort required to help those who otherwise would have little chance of succeeding in a mainstream vocational education program. It would place the federal government in a role of helping states and local communities to take the best from what we have learned from successful federal efforts over the past decade to improve the preparation and transition of special population youth, from school to work, and to begin to institutionalize, as part of mainstream education, a way to improve the productive capacity of these youth for employment.

Federal Support for Research and Development

Basically, we are in the midst of some major, structural transitions in the workplace, and, simultaneously, we have no system to sort out where the jobs are, where the demand will be, and the requirements for entering those jobs.

Due to the changing types of jobs and the skills they will require of workers, we must now develop a future base of information in order to reconstruct training and retraining. Our traditional approach to occupational demand projections, utilizing a historical base - what has been - is no longer adequate in meeting our needs in determining program change.

We recommend federal support of hands-on research to learn more about the workplace - the demand and requirements of jobs. Computerized analyses of historical data - often manipulative - is not useful in determining the future of jobs. The federal government should encourage local studies, conducted collaboratively by employers and vocational educators, to sort out emerging job demands and the knowledge and skills which they will require.

SUMMARY

We at AVA are extremely pleased that the House has constucted this series of panel hearings, since probably no issue is of greater consequence, overall, to the economic future of this nation than technology and its impact on employment. We face some grave consequences if specific action is not taken in the very near future.

Our attempt here has been to provide you with a comprehensive and up-to-date picture of vocational eduction and its role, past, present and future, in the training and retraining of a techncially skilled workforce. That role is clear; however, the problems we face in implementing that role require careful scrutiny and immediate action. While much has been done to develop new programs and to redesign existing programs in light of new technology, significantly greater changes must permeate the vocational education delivery system - at both the secondary and postsecondary levels.

The agenda which we propose for legislative reform is sound, based upon a sequence of steps to move us from where we are now to where we must be. This program will occur, however, only under the direct leadership of Congress - in setting into motion national policies which will ensure a skilled workforce adquately trained to compete in tomorrow's modern world. Vocational education has the potential to do the job.

APPENDIX A

TECHNOLOGIES EXPECTED TO IMPACT VO-TECH OCCUPATIONS

The technologies listed and described below are those which are perceived to have a noticeable impact on vocational-technical occupations. For purposes of presentation, the technological innovations are first listed under their specific occupational cluster areas and then, following the listings, each one is described in a short paragraph. Note that many of the new technologies listed under TECHNICAL and TRADE & INDUSTRIAL may also impact the other occupational cluster areas.

TECHNICAL AND TRADE & INDUSTRIAL

- Process Control
- Microelectronic Monitors/Controls
- Computers/Software
- Optical Data Transmission
- CAD/CAM
- Robotics
- Automotive Services/Electronics
- Renewable Energy Technologies
- Machining
- Welding

Process Control involves automation of simple or complex industrial processes. A simple or singular process sequence is sometimes referred to as a process "loop." In a well-automated plant, the various loops may be integrated into a complex series. Microprocessors with programmable features contribute to the advancement of process control technology. Related terms include "numeric control" and "direct digital control."

Microelectronic Monitors and Controls encompass those components of larger systems which may automatically control parts of the larger system, or which can monitor and display to human operators indications of what's going on within the system and transmit operators' instructions to the system. New graphics, voice recognition and synthesis, and sensor capabilities are among the advances in this technology area.

Microcomputers or Personal Computers, also called "desktop" computers, are by now somewhat familiar to us all. Small-sized and affordable by comparative standards ($5,000 or less will buy a sophisticated system), these machines incorporate many of the logical capabilities of larger computers and can be programmed to perform many of the same sorts of tasks. This is made possible by microprocessor technology. Microprocessors, based on large-and very-large-scale integrated circuits, have sometimes been called "computers-on-a-chip." Microprocessors are used not only in microcomputers but in many other "hardware" systems which can then perform computer-like functions.

The concept of Software is not new, but advanced computer technologies and increasingly sophisticated computer applications have caused software technology to develop and change accordingly. Software refers generally to the computer programs which direct the machine to perform specific tasks. New programming "languages" and techniques, and the development and use of new and important general or special-purpose computer programs, constitute the areas of interest in software technology. The term "software engineering" has come into use in recent years to describe systematic approaches to computer program development.

Optical Data Transmission is a technology which is made possible by advancements in fiber optics--the transmission of light through transparent fiber cables. Light from a point source (normally, a low-power laser) can be used to send the intelligible messages by optical, rather than electrical, impulses. Transmission of such signals over optic cable can have some advantages over electrical wire transmission.

Microprocessors and computer systems form the basis of a set of technologies specifically geared toward the design or fabrication of parts and products. Computer-based design and manufacture is the label used herein to cover these systems known variously as CAD/CAM (computer-aided design/computer-assisted manufacture) and CIM (computer-integrated manufacture), used mainly but not exclusively in the production of industrial parts and part assemblies.

Robotics, the field of interest concerned with the construction, maintenance and behavior of robots, is defined here within the context of the use of robots in industrial or business applications. Robots are defined as reprogrammable, multifunctional manipulators designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks.

Electronics has emerged as an essential, functional element in automotive design and manufacture, and will greatly alter the skills needed for provision of Automotive Services in the immediate future. Electronic technology now affects or controls automotive components including alternators, voltage regulators, ignition systems, gasoline fuel injection, etc. Automotive design, weight and the materials used in manufacture of parts are changing dramatically with transverse engines, front-wheel drives and the expanding use of plastics and composites.

Renewable Energy Technologies (RETs) are receiving renewed emphasis and application. Sources or methods for the production of usable energy such as solar, wind power and biomass conversion are being studied and implemented in agricultural, architectural and other settings as economic, conservation, and/or fuel-saving measures.

Some of the activities of Machining (such as turning, milling, drilling and boring, grinding, finishing, framing, tooling, etc.) are being revolutionized by the newest technologies. Higher-speed machining, new uses of lasers, microelectronic controls and operator-less manufacturing systems are bringing about improvements which in turn should boost machine shop productivity.

Welding, specifically the two major processes of resistance welding and arc welding, will see changes in application through automation of the standard processes in the near term. Continued automation in the automotive and other large manufacturing plants is predicted. Robots will handle many of the welding jobs formerly performed by skilled workers. Automation of arc welding is also increasing in high-production plants.

HEALTH OCCUPATIONS

- Computer/Software
- Database Systems
- Diagnostic Imaging
- Physiological Monitoring
- Controlled Infusion
- Health Care Delivery Systems

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Database Systems are computer systems and programs which help organize, update and transmit information, particularly selected subsets of information culled from a much larger set called a database. Databases often contain a large number of "records" which are similar in structure but different in specifics. For example, a record may contain a person's name, age, height, weight, and so forth. If a database is formed from such records, the database system may be used to retrieve all or part of this information for a given individual, to list the names of all individuals within a specified age range, to change or update records, etc. The master computer program which facilitates these information transactions is called a database management system (DBMS). When information is handled over long distances in coordinated fashion (such as in confirming an airline reservation or in using a bank's teller machine), the process may be referred to as distributed data processing (DDP).

X-radiation is but one method available nowadays for providing a picture of what goes on inside a living person or animal without physically entering the subject. Diagnostic Imaging technology refers to the various new and developing methods which have expanded the role of the radiologic technician and similar health care workers. Specific methods included under this rubric include ultrasound, computed tomography, and nuclear magnetic resonance, among others.

Advances in microelectronics, sensors, and other instrument components have led to changes in Physiological Monitoring devices and systems, such as might be used in cardiac/intensive care but also in general patient care. These devices and systems include instruments which can monitor or display physiological functions, alerting the health care personnel immediately to important changes and developments.

Controlled Infusion devices are used for precise delivery of liquids (such as drug or nutritive solutions), usually intravenously, to a hospital patient. Advances are making intravenous infusion safer and less time-consuming, semi-automating some of the tasks involved in nursing care.

Health Care Delivery Systems are changing with the times. These "soft" technologies, new and innovative organizational systems for promotion and maintenance of good health, are having impact on the nation's response to changing health costs, demands, and disease trends. An example of a changing delivery system is the health maintenance organization (HMO), a form of prepaid health care plan.

AGRICULTURE OCCUPATIONS

- Computers/Software
- Animal Production
- Pest Management
- Micropropagation of Plants
- Conservation Tillage
- Aquaculture
- Modern Machinery
- Planting Methods/Equipment
- Trickle Irrigation

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Animal Production is a diverse and changing field. New and improved systems and techniques in the general care and husbandry of animals, applied animal agriculture, agriculture disciplines that support animal production, and applications of biological sciences involved in such activities demand new and changing skills and training.

Integrated Pest Management (IPM) is a unified, conservation-oriented approach to the control of animal and plant pests in agricultural endeavors. It involves optimal co-use of different chemical, biological and ecological control methods, with an eye toward long-range impact and cost control.

Micropropagation of Plants With Preplanned Genetic Characteristics refers to the use of tissue culture systems for mass propagation of selected plants by cloning or asexual reproduction. Mass production of new plants may arise from a single cell through miosis or division from leaf stem or root cuttings, meristems, runners or stem tips. Systems of mass propagation may be economical and a unique means of propagating improved disease-free specimens.

Soilless Plant Propagation-Nutrient Film Technique refers to systems and techniques for producing high-value crops or plants without using soil as a rooting substrate. This can be accomplished by hydroponics or soilless culture, or by using a variety of substrates other than soil.

Conservation Tillage is a technology in which the residue of the previous crop is left as a surface mulch through which the new crop is seeded, and weed control is effected by appropriately applied chemical herbicides. It is the most effective soil management practice yet devised as an erosion preventative and is becoming increasingly important for the conservation of soil, water, soil organic matter, and in the use of fossil energy.

Renewable Energy Technologies (RETs) are receiving renewed emphasis and application. Sources or methods for the production of usable energy such as solar, wind power and biomass conversion are being studied and implemented in agricultural, architectural and other settings as economic, conservation, and/or fuel-saving measures.

Following the rapid advancements in horsepower and operator convenience made in the last decade, Agricultural Machinery and Equipment are undergoing even further changes brought about by widespread applications of electronics and computer technology. Many pieces of machinery or equipment will be loaded with sensors, monitors, relays and even onboard computer systems that will enhance efficiency, cut crop losses, and save money.

A blending of electronics and computers will soon make a critical impact on Planting Methods and Equipment. Improvements in planters and seeders will make possible precise seeding depth and spacing and adjustments by the operator in planting patterns to varying conditions even within the same field. New seeding, fertilizing and pesticide application methods are called for with the advent of conservation tillage practices such as low-till or no-till.

Aquaculture embodies those methods and systems for the recent improvement and expansion of the age-old technology of raising aquatic plants and animals in natural or man-made bodies of water as a commercial venture. Included in the "crops" are many varieties of fish (trout, catfish, salmon, etc.) and shellfish or seafood (shrimp, lobsters, oysters, etc.,) or plants such as an algae (used for cattle food) and water chestnuts, etc.

Drip or Trickle Irrigation refers to the type of irrigation system in which, through a series of automatically controlled surface or subsurface water lines and outlets called emitters, water and other water soluble materials such as fertilizers, fungicides and insecticides can be applied directly to the plants, with considerable application cost savings.

HOME ECONOMICS OCCUPATIONS

- Computer/Software
- Household Appliances
- Videotex

Microcomputers or Personal Computers, also called "desktop" computers, are by now somewhat familiar to us all. Small-sized and affordable by comparative standards ($5,000 or less will buy a sophisticated system), these machines incorporate many of the logical capabilities of larger computers and can be programmed to perform many of the same sorts of tasks. This is made possible by microprocessor technology. Microprocessors, based on large-and very-large-scale integrated circuits, have sometimes been called "computers--on-a-chip." Microprocessors are used not only in microcomputers but in many other "hardware" systems which can then perform computer-like functions.

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New technologies are influencing the development of Household Appliances. Improvements in energy efficiency, new appliance categories such as convection ovens and induction ranges, and advances in user control capability (for example, the ability to "program" a defrost and cooking cycle within a microwave oven) are of particular interest.

Videotex systems use modern television technology, broadcast and cable, to provide information selectively to subscribers - and sometimes to receive information back from them directly. Videotex is used as a generic term for such systems, and incorporates "teletext" and "viewdata." Teletext systems provide information to the viewer, while viewdata systems, which depend on cable networks, allow information (such as consumer's product orders) to be sent back to the central system by the subscriber at home.

DISTRIBUTION/MARKETING OCCUPATIONS

- Computers/Software
- Database Systems
- Point-of-Sale Equipment
- Inventory Control Systems

Microcomputers or Personal Computers, also called "desktop" computers, are by now somewhat familiar to us all. Small-sized and affordable by comparative standards ($5,000 or less will buy a sophisticated system), these machines incorporate many of the logical capabilities of larger computers and can be programmed to perform many of the same sorts of tasks. This is made possible by microprocessor technology. Microprocessors, based on large-and very-large-scale integrated circuits, have sometimes been called "computers-on-a-chip." Microprocessors are used not only in microcomputers but in many other "hardware" systems which can then perform computer-like functions.

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Database Systems are computer systems and programs which help organize, update and transmit information, particularly selected subsets of information culled from a much larger set called a database. Databases often contain a large number of "records" which are similar in structure but different in specifics. For example, a record may contain a person's name, age, height, weight, and so forth. If a database is formed from such records, the database system may be used to retrieve all or part of this information for a given individual, to list the names of all individuals within a specified age range, to change or update records, etc. The master computer program which facilitates these information transactions is called a database management system (DBMS). When information is handled over long distances in coordinated fashion (such as in confirming an airline reservation or in using a bank's teller machine), the process may be referred to as distributed data processing (DDP).

Advances in technologies of Marketing include both technical systems for the advertisement or distribution of products in new and effective ways, and organizational/strategic changes designed to promote the marketing function. The former are illustrated by point-of-sale equipment (product code scanning) and "electronic catalogs," the latter by the intrusion into the automated teller machine services market of non-banking firms such as department store chains.

Inventory Control Systems are technologies which facilitate the efficient and cost-effective movement of supplies and products to and from warehouses associated with sales or manufacturing firms. Computer technology and related advancements have made possible not only automated retrieval and reordering (e.g., through product numbering and scanning), but also more sophisticated methods of paring down inventories to the amounts needed and the better utilization of computational methods for controlling other inventory costs.

BUSINESS AND OFFICE OCCUPATIONS

- Computers/Software
- Worker Participation in Management
- Inventory Control Systems
- Office Automation
- Word Processing
- Work Scheduling

Microcomputers or Personal Computers, also called "desktop" computers, are by now somewhat familiar to us all. Small-sized and affordable by comparative standards ($5,000 or less will buy a sophisticated system), these machines incorporate many of the logical capabilities of larger computers and can be programmed to perform many of the same sorts of tasks. This is made possible by microprocessor technology. Microprocessors, based on large-and very-large-scale integrated circuits, have sometimes been called "computers-on-a-chip." Microprocessors are used not only in microcomputers but in many other "hardware" systems which can then perform computer-like functions.

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Worker Participation in Management refers to organizational structures and functions which involve vocational workers in efforts to improve production or quality. These "soft" technologies include quality control (QC) circles, an important new development, as well as quality of worklife groups and some methods of organization development.

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Office Automation involves the broadening use of computer technology in the office environment. Office automation, however, is not simply the use of computer technology to support office work. Rather, it includes the proliferation of computer-based work stations throughout the office and at all levels from clerk to executive. In addition to the now prevalent word processing functions, electronic mail and filing, data storage and retrieval, "personal" computing including graphics capabilities and interactive on-line communication and data sharing systems are some of the elements of the office of the future.

Word Processing involves the application of computer technology to the typewriting or keyboarding process. It is sometimes described as the key to office automation and is used in the development, production and revision of such materials as long documents, reports, form letters, memos, mailing labels and lists, and other correspondence. Other functions can include calendaring, timekeeping and billing operations. Information entered into a word processing system can easily be edited, revised, reformatted, changed by deletion or insertion of data and generally polished into a better final product without rekeyboarding the entire document.

Alternative methods and practices of Work Scheduling are changing the ways and the places of work. A number of new approaches are being tried in business and industry to adapt to the needs of both the employer and employee. Job-sharing, "flextime," work at home, in satellite centers or in other locations are some of the alternative working arrangements being used.

APPENDIX B

BRIEF DESCRIPTION OF TECHNICAL CORE

ELECTRICITY AND ELECTRONICS

Basic knowledge and skills in dc and ac electrical circuits to include circuit analysis, recognition and use of electrical components and electrical measurement instruments. Topics presented include voltage, resistance, current, power, Ohm's law, inductors, capacitors, series and parallel circuits, and magnetic circuits and devices.

ELECTRONIC DEVICES

Working knowledge of modern electronic devices and circuits in which they are employed. Electronic devices covered include PN diodes, Zener diodes, pnp and npn transistors, SCRs, unijunction transistors, JFETs, MOSFETs, and integrated circuits containing these devices. Devices used as digital switches, analog amplifiers and oscillators. Input and output devices; analog and digital systems.

CIRCUIT ANALYSIS (Replaces ELECTRONIC DEVICES in Computer and Microelectronics Specialty Areas)

Equivalent circuits; loop and mode analysis; series/parallel circuits; resonance; filters; transients; time constants; pulse power circuits (pfn, Marks gen, etc.).

GRAPHICS

A beginning course in drawing/graphics. Includes lettering, line work, electrical symbols, mechanical symbols, blueprints, schematics, and shop drawings.

PROPERTIES OF MATERIALS

Comprehensive description of material properties under the separate classifications of physical, chemical, mechanical, thermal, electrical, magnetic, acoustical and optical properties. Typical properties studied include density, porosity, hygroscopicity, corrosiveness, composition, tension, compression, flexure, shear, impact, fatigue, elasticity, resilience, ductility, hardness, lubricity, brittleness, conductivity, heat capacity, permeability, and acoustic/optic transmissivity and reflectivity. Resource tables/handbooks identifed and used extensively.

MECHANICAL DEVICES AND SYSTEMS

Belt drives, chain drives, gear drives, drive trains, linkages, fans, blowers, valves. Covers operational procedures, use, maintenance, troubleshooting, repair and replacement.

HEATING AND COOLING

Radiation, convection, conduction and refrigeration; heat exchangers and heat balancing; temperature control and analysis of heat balance requirementes for typical industrial devices and systems.

FLUID POWER SYSTEMS

Overview of fluid power technology. Working knowledge of components in fluid power circuits. Hydraulic and pneumatic systems. Topics include fundamentals of fluid dynamics, fluid storage, conditioning and maintenance, pumps and compressors, actuators and fluid motors, fluid distribution and control devices, fluid circuits, and troubleshooting.

INSTRUMENTATION AND CONTROL

Practical knowledge and skills in specification, use and calibration of measuring devices. Principles and applications of automatic control processes. Topics include process control, pressure/level measurements, flow measurement, temperature measurement, mechanical measurement and pneumatic controls.

COMPUTER APPLICATIONS

Use of microprocessors and control devices for automated manufacturing, process control and data acquisition. Interfaces signals from measurement devices with computers; programs computer to analyze system condition from measured data and determined control device change required to optimize system operation; conditions output command signal from computer to automatically operated system control devices such as valves, pumps, boilers, etc.

MANUFACTURING PROCESSES

This course provides a background in manufacturing materials and manufacturing methods employed in cold working processes. Through lecture, demonstration, and practical applications the student becomes familiar with various types of machine tools, tooling, measuring, and inspection procedures. Automation and numerical control for machine tools are introduced.

INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT

This course deals with the source, distribution, and use of electrical power in industrial plants. The first part of the course describes ac electrical power as it arrives at the plant substation and the electrical equipment needed to transform it to useful voltages, distribute it effectively and protect it from overcurrent conditions. Equipment typically includes transformers, switchgear, fuses and relays. The second part of the course deals with electromechanical equipment required to convert electrical power into useful, rotational mechanical energy. Equipment typically includes ac and dc motors, motor controllers and synchromechanisms.

APPENDIX C

TYPICAL HIGH-TECHNOLOGY PROGRAMS

- COMPUTERS
- MICROELECTRONICS
- NONDESTRUCTIVE TESTING
- CAD/CAM
- INSTRUMENTATION AND CONTROL
- AUTOMATED MANUFACTURING
- ROBOTICS
- LASERS
- ENERGY CONSERVATION AND USE

PROPOSED HIGH TECHNOLOGY CURRICULUM IN COMPUTERS

APPLIED MATH AND SCIENCE

- ALGEBRA/TRIGONOMETRY
- ANALYTIC GEOMETRY
- PRECALCULUS
- TECHNICAL PHYSICS

COMMUNICATIONS

- TECHNICAL COMMUNICATIONS
- COMPUTER BASICS

SOCIOECONOMIC

- ECONOMICS
- INDUSTRIAL RELATIONS

TECHNICAL CORE

- ELECTRICITY/ELECTRONICS
- GRAPHICS
- PROPERTIES OF MATERIALS
- MECHANICAL DEVICES
- MANUFACTURING PROCESSES
- CIRCUIT ANALYSIS
- HEATING AND COOLING
- FLUID POWER
- INSTRUMENTATION AND CONTROL
- COMPUTER APPLICATIONS
- INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT

SPECIALTY

- DIGITAL FUNDAMENTALS
- ACTIVE DEVICES AND CIRCUITS
- DIGITAL DEVICES AND TECHNIQUES
- ANALOG DEVICES AND SYSTEMS
- COMPUTER CIRCUITS AND PROGRAMMING
- DIGITAL COMPUTERS

POTENTIAL COMPUTER TECHNOLOGY SPECIALTY

DIGITAL FUNDAMENTALS

Number systems; codes; Boolean algebra; truth tables; Venn diagrams; Karnaugh maps; binary-decimal conversions; basic logic components (AND gates, OR gates, and flip-flops); introduction to machine language programming.

ACTIVE DEVICES AND CIRCUITS

Semiconductor theory; pn junctions, Zener diodes and other two-terminal devices; bipolar junction transistors (npn, pnp); common base/common emitter amplifiers; vacuum tube diodes, triodes, and circuits.

DIGITAL DEVICES AND TECHNIQUES

Combination logic; binary counters; shift registers; timers; multiplexers; microprocessors; memory devices; operation codes; computer communications with the outside world.

ANALOG DEVICES AND SYSTEMS

Oscillators; wave generators; power supplies; SCRs, ICs, op amps, FETs, JFETs, MOSFETs, triacs; indicators and displays; analog computers.

COMPUTER CIRCUITS AND PROGRAMMING

ROM logic design; algorithmetic state machines; microcomputer architecture and main-frame computers; machine language; BASIC, FORTRAN, PASCAL.

DIGITAL COMPUTERS

Theory and operation of mini- and microcomputers; input-output peripheral equipment; memory elements; arithmetic elements; data transmittal systems; interfacing; digitized test equipment; diagnostic programming; installation; troubleshooting and repair of computers used for computations and process control.

PROPOSED HIGH TECHNOLOGY CURRICULUM IN MICROELECTRONICS

APPLIED MATH AND SCIENCE

- ALGEBRA/TRIGONOMETRY
- ANALYTIC GEOMETRY
- PRECALCULUS
- TECHNICAL PHYSICS

COMMUNICATIONS

- TECHNICAL COMMUNICATIONS
- COMPUTER BASICS

SOCIOECONOMIC

- ECONOMICS
- INDUSTRIAL RELATIONS

TECHNICAL CORE

- ELECTRICITY/ELECTRONICS
- GRAPHICS
- PROPERTIES OF MATERIALS
- MECHANICAL DEVICES
- MANUFACTURING PROCESSES
- CIRCUIT ANALYSIS
- HEATING AND COOLING
- FLUID POWER
- INSTRUMENTATION AND CONTROL
- COMPUTER APPLICATIONS
- INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT

SPECIALTY

- DIGITAL FUNDAMENTALS
- ACTIVE DEVICES AND CIRCUITS
- DIGITAL DEVICES AND TECHNIQUES
- ANALOG DEVICES AND SYSTEMS
- RF/MICROWAVE COMMUNICATIONS
- FIBER OPTICS COMMUNICATIONS

POTENTIAL MICROELECTRONICS TECHNOLOGY SPECIALTY

DIGITAL FUNDAMENTALS

Number systems; codes; Boolean algebra; truth tables; Venn diagrams; Karnaugh maps; binary-decimal conversions; basic logic components (AND gates, OR gates, and flip-flops); introduction to machine language programming.

ACTIVE DEVICES AND CIRCUITS

Semiconductor theory; pn junctions, Zener diodes and other two-terminal devices; bipolar junction transistors (npn, pnp); common base/common emitter amplifiers; vacuum tube diodes, triodes, and circuits.

DIGITAL DEVICES AND TECHNIQUES

Combination logic; binary counters; shift registers; timers: multiplexers; microprocessors; memory devices; operation codes; computer communications with the outside world.

ANALOG DEVICES AND SYSTEMS

Oscillators; wave generators; power supplies; SCRs, ICs, op amps, FETs, JFETs, MOSFETs, triacs; indicators and displays; analog computers.

RF/MICROWAVE COMMUNICATIONS

Modulation techniques (AM, FM, phase); transmitters; receivers; microwave power-tubes; microwave measurements; transmission lines; waveguides; antennas.

FIBER OPTICS COMMUNICATIONS

Laser diodes; LEDs; characteristics of optical fibers; coupling devices; receivers; system configurations; rolloff; insertion loss; digital transmission; integrated circuits.

CORD PROPOSED HIGH TECHNOLOGY CURRICULUM IN NONDESTRUCTIVE TESTING

APPLIED MATH AND SCIENCE

- ALGEBRA/TRIGONOMETRY
- ANALYTIC GEOMETRY
- PRECALCULUS
- TECHNICAL PHYSICS

COMMUNICATIONS

- TECHNICAL COMMUNICATIONS
- COMPUTER BASICS

SOCIOECONOMIC

- ECONOMICS
- INDUSTRIAL RELATIONS

TECHNICAL CORE

- ELECTRICITY/ELECTRONICS
- GRAPHICS
- PROPERTIES OF MATERIALS
- MECHANICAL DEVICES
- MANUFACTURING PROCESSES
- ELECTRONIC DEVICES
- HEATING AND COOLING
- FLUID POWER
- INSTRUMENTATION AND CONTROL
- COMPUTER APPLICATIONS
- INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT

SPECIALTY

- FUNDAMENTALS OF NONDESTRUCTIVE TESTING
- ULTRASONIC NONDESTRUCTIVE TESTING
- RADIOGRAPHIC NONDESTRUCTIVE TESTING
- EDDY CURRENT NONDESTRUCTIVE TESTING
- MAGNETIC PARTICLE AND LIQUID PENETRANT NONDESTRUCTIVE TESTING
- SPECIAL METHODS OF NONDESTRUCTIVE TESTING

POTENTIAL NONDESTRUCTIVE TESTING SPECIALTY

FUNDAMENTALS OF NONDESTRUCTIVE TESTING

Faults in weld seams, castings, forgings, extrusions, composites, roll-plate products, circuit boards, etc; overview and identification of techniques used to locate and evaluate faults; visual and leak detection; codes and standards.

ULTRASONIC NONDESTRUCTIVE TESTING

Principles; test equipment; test procedures and evaluation; applications; NDT/NDE codes/standards.

RADIOGRAPHIC NONDESTRUCTIVE TESTING

Principles; test equipment; test procedures and evaluations; applications, NDT/NDE codes/standards.

EDDY CURRENT NONDESTRUCTIVE TESTING

Principles; test equipment; test procedures and evaluation; applications, NDT/NDE codes/standards.

MAGNETIC PARTICLE AND LIQUID PENETRANT NONDESTRUCTIVE TESTING

Principles; test equipment; test procedures and evaluation; applications, NDT/NDE codes/standards.

SPECIAL METHODS OF NONDESTRUCTIVE TESTING

Sonics; infrared; acoustic emission; microwave; optical holography; acoustical holography.

PROPOSED HIGH TECHNOLOGY CURRICULUM IN CAD/CAM

APPLIED MATH AND SCIENCE

- ALGEBRA/TRIGONOMETRY
- ANALYTIC GEOMETRY
- PRECALCULUS
- TECHNICAL PHYSICS

COMMUNICATIONS

- TECHNICAL COMMUNICATIONS
- COMPUTER BASICS

SOCIOECONOMIC

- ECONOMICS
- INDUSTRIAL RELATIONS

TECHNICAL CORE

- ELECTRICITY/ELECTRONICS
- GRAPHICS
- PROPERTIES OF MATERIALS
- MECHANICAL DEVICES
- MANUFACTURING PROCESSES
- ELECTRONIC DEVICES
- HEATING AND COOLING
- FLUID POWER
- INSTRUMENTATION AND CONTROL
- COMPUTER APPLICATIONS
- INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT

SPECIALTY

- ENGINEERING GRAPHICS
- CAD/CAM SYSTEM HARDWARE AND FUNCTIONS
- INTERACTIVE COMPUTER GRAPHICS I
- INTERACTIVE COMPUTER GRAPHICS II
- COMPUTER GRAPHICS APPLICATIONS
- CAD/CAM INTERFACE IN PRACTICE

POTENTIAL CAD/CAM SPECIALTY

ENGINEERING GRAPHICS

Orthographic projection, dimensioning sections, auxiliary views, pictorial views, detail and assembly drawings, etc.

CAD/CAM SYSTEM HARDWARE AND FUNCTIONS

Graphics terminals, point-and-position devices, keyboards, plotters, computer networks; geometric modeling, analysis, kinematics, drafting, numerical control, process planning, robotics, factory management.

INTERACTIVE COMPUTER GRAPHICS I

Operation of a computer graphics system; 2-D geometric drawings; use as a design/drafting tool; learn/apply industrial practices for creation/storage of drawings.

INTERACTIVE COMPUTER GRAPHICS II

3-D design/construction; descriptive geometry; creating planes/surfaces; perspective views; stress analysis.

COMPUTER GRAPHICS APPLICATIONS

3-D mechanical designs; wiring diagrams; schematics; circuit boards; create/store/document mechanical design and electrical design information.

CAD/CAM INTERFACE IN PRACTICE

Manufacturing by computer; machine-tool controls; robots; artificial intelligence; the automated cell; the fully automated factory; CAD/CAM systems in operation.

PROPOSED HIGH TECHNOLOGY CURRICULUM IN INSTRUMENTATION AND CONTROL

APPLIED MATH AND SCIENCE

- ALGEBRA/TRIGONOMETRY
- ANALYTIC GEOMETRY
- PRECALCULUS
- TECHNICAL PHYSICS

COMMUNICATIONS

- TECHNICAL COMMUNICATIONS
- COMPUTER BASICS

SOCIOECONOMIC

- ECONOMICS
- INDUSTRIAL RELATIONS

TECHNICAL CORE

- ELECTRICITY/ELECTRONICS
- GRAPHICS
- PROPERTIES OF MATERIALS
- MECHANICAL DEVICES
- MANUFACTURING PROCESSES
- ELECTRONIC DEVICES
- HEATING AND COOLING
- FLUID POWER
- INSTRUMENTATION AND CONTROL
- COMPUTER APPLICATIONS
- INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT

SPECIALTY

- ELECTRONIC AND PNEUMATIC CONTROL ELEMENTS
- CONTROL SYSTEMS I
- CONTROL SYSTEMS II
- ANALYTICAL INSTRUMENTATION
- INTEGRATED PLANT CONTROL

POTENTIAL INSTRUMENTATION AND CONTROL SPECIALTY

ELECTRONIC AND PNEUMATIC CONTROL ELEMENTS

Basic operation; on-off, proportional, reset, derivative controls; recorders; indicating devices; advantages/disadvantages of pneumatic, electronic, hybrid controls.

CONTROL SYSTEMS I

Introduction to automatic feedback control; control system theory; step analysis and frequency response; control valve selection and sizing; proportional, reset and derivative controls.

CONTROL SYSTEMS II

For a given, simple process: selection of appropriate instrumentation; preparation of instrumentation diagram; cascade and ratio control; feed-forward control; loop troubleshooting; microprocessor uses.

ANALYTICAL INSTRUMENTATION

Use of analytical instruments in process control loops; oxygen analyzers, gas chromatographs, UV analyzers; sampling; instrument care and maintenance.

INTEGRATED PLANT CONTROL

Multiloop control of processes including feed-forward control, feedback control, trips, limits; advantages/disadvantages of integrated control.

CONTROL LOOP DIAGNOSIS AND MAINTENANCE

Logic diagrams; problem diagnostics in integrated plant control systems; system troubleshooting. Loop and computer maintenance.

PROPOSED HIGH TECHNOLOGY CURRICULUM IN AUTOMATED MANUFACTURING

APPLIED MATH AND SCIENCE

- ALGEBRA/TRIGONOMETRY
- ANALYTIC GEOMETRY
- PRECALCULUS
- TECHNICAL PHYSICS

COMMUNICATIONS

- TECHNICAL COMMUNICATIONS
- COMPUTER BASICS

SOCIOECONOMIC

- ECONOMICS
- INDUSTRIAL RELATIONS

TECHNICAL CORE

- ELECTRICITY/ELECTRONICS
- GRAPHICS
- PROPERTIES OF MATERIALS
- MECHANICAL DEVICES
- MANUFACTURING PROCESSES
- ELECTRONIC DEVICES
- HEATING AND COOLING
- FLUID POWER
- INSTRUMENTATION AND CONTROL
- COMPUTER APPLICATIONS
- INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT

SPECIALTY

- MANUFACTURING TOOLS, FIXTURES AND MEASUREMENTS
- CAD/CAM SYSTEM HARDWARE AND FUNCTIONS
- CNC PROGRAMMING
- FUNDAMENTALS OF ROBOTICS
- AUTOMATED INTEGRATED MANUFACTURING SYSTEMS
- ELECTIVE

POTENTIAL SPECIALTY IN AUTOMATED MANUFACTURING PROCESSES

MANUFACTURING TOOLS, FIXTURES AND MEASUREMENTS

Covers the elements of jig and fixture design, tool design, and die design. Introduction to the science of measurement and tools/standards of measurement as practiced in metrology.

CAD/CAM SYSTEM HARDWARE AND FUNCTIONS

Graphics terminals, point-and-position devices, keyboards, plotters, computer networks; geometric modeling, analysis, kinematics, drafting, numerical control, process planning, robotics, factory management.

CNC PROGRAMMING

Introduction to numerical control of machining operations. Study of languages (APT, COMPACT II) and programming of automated machine tools. Study of CNC and DNC configurations of machine tools and computers. Analysis/study of typical industrial CNC/DNC systems - such as those designed by Cincinnati Milacron Inc. and Allen Bradley Company.

FUNDAMENTALS OF ROBOTICS

Robot moving parts; end effectors; drives; control systems; limited sequence operation; point-to-point playback; continuous path control playback; robots for welding, assembly, painting, machine loading/unloading.

AUTOMATED INTEGRATED MANUFACTURING SYSTEMS

Study of existing "automated" systems in the automotive construction, aerospace and tool industries. Class project design of a suitable (realistic) computer-integrated manufacturing system.

CORD PROPOSED HIGH TECHNOLOGY CURRICULUM IN ROBOTICS

APPLIED MATH AND SCIENCE

- ALGEBRA/TRIGONOMETRY
- ANALYTIC GEOMETRY
- PRECALCULUS
- TECHNICAL PHYSICS

COMMUNICATIONS

- TECHNICAL COMMUNICATIONS
- COMPUTER BASICS

SOCIOECONOMIC

- ECONOMICS
- INDUSTRIAL RELATIONS

TECHNICAL CORE

- ELECTRICITY/ELECTRONICS
- GRAPHICS
- PROPERTIES OF MATERIALS
- MECHANICAL DEVICES
- MANUFACTURING PROCESSES
- ELECTRONIC DEVICES
- HEATING AND COOLING
- FLUID POWER
- INSTRUMENTATION AND CONTROL
- COMPUTER APPLICATIONS
- INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT

SPECIALTY

- FUNDAMENTALS OF ROBOTICS
- ROBOT SUBSYSTEMS
- ROBOT PROGRAMMING
- INDUSTRIAL ROBOTS
- USE OF ROBOTS IN AUTOMATED MANUFACTURING
- ELECTIVE

POTENTIAL ROBOTICS SPECIALTY

FUNDAMENTALS OF ROBOTICS (with a Teaching Robot Lab)

Moving parts (arm, wrist, hand); end effectors (hands, grippers pickups); control systems (mechanical stops, limit switches, computer control); drives (electric, hydraulic, pneumatic); limited sequence; point-to-point playback; continuous path control playback.

ROBOT SUBSYSTEMS (with a Teaching Robot Lab)

Electronic; hydraulic, pneumatic; servomechanical, electromechanical; sensors; microprocessors; computers.

ROBOT PROGRAMMING (with a Teaching Robot Lab)

Elements of computer control systems; robot computer languages; teach modes; playback modes; analysis of computer systems in typical industrial robots (PUMA, UNIMATE); data acquisition/handling/conversion; artificial intelligence.

INDUSTRIAL ROBOTS

Familiarization with robot assembly and operation; study of current industrial robots (UNIMATE, PRAB, Cincinnati Milacron, Inc., Nordson, etc.); visits to industrial sites; seminars/lectures by industrial representatives.

USE OF ROBOTS IN AUTOMATED MANUFACTURING

CAD/CAM systems and robots; integrated computer-aided manufacturing (ICAM); ICAM stages--process, station cell, center, factory; role of the robot in ICAM; robot workcenters and the fully-automated plant; case studies.

ELECTIVE

Mr. GEPHARDT. Thank you and thank all of you very much for excellent and helpful testimony. Our first questioner will be Representative Dymally.

Mr. DYMALLY. Thank you, Mr. Chairman.

I think I will start with Dr. Levin. What do you see as the best way, Dr. Levin, to provide mobility between the low-skill or low-wage jobs and the high-skill or high-wages jobs?

Dr. LEVIN. I think that that is a difficult question, but I will try to answer in the sense that I think that the kinds of programs that I spoke of are not just for skilled workers. We have purposely taken into this program the communication workers, or the less skilled. We chose them because many of them are less skilled and because they represent a large number of women and minorities in that particular union in our State.

We want to offer them exactly the same thing that we are offering the very skilled machinists, although we are starting everybody with the basic skill program. I did not get a chance to describe that.

I think that your question really focuses on one of the problems with introducing technology and that is that the gap can get greater between the skilled and the unskilled and between women and men and minorities and nonminorities.

I think that in legislation, there have to be incentives for people who will put these programs in our cities, which is what we have chosen to do in these programs. One is in Union, N.J., and the other in Jersey City.

These programs should also integrate other goals of our Government, such as affirmative action with these new goals. In conversations about technology training programs, I have been very disheartened to hear certain people in education say that they did not want to talk about affirmative action and unskilled people as criteria for this new program. It was as if those are other programs, and I think that we have to continue with these other goals of our Government and put them as criteria and incentives into new programs that you fund.

Mr. **Dymally**. Thank you very much.

Dr. Swain, can you make some specific suggestions about the best way to divide Federal, State, and local government roles in the training and retraining area? How do we separate one from the other?

Dr. **Swain**. I think that probably in the retraining area, we need a good deal of decentralization on policy, so I would encourage at the Federal level a lot of flexibility and enabling of flexibility wherever possible in legislative approaches.

This is, at the Federal level, the fundamental perspective that is necessary. Probably in the next decade or so, providing some additional funding to the States will be wise because some States, at least, are unable to fund it.

Now, the States, I think, ought to work very closely with the instructional agencies in each State. In Kentucky, I would say, we have a very decentralized kind of approach to higher education and education in general. What we need, however, from the State government is further funding, further focused encouragement to various kinds of educational institutions to get into training and retraining in ways that they have not done before. Providing incentives, but again with flexibility and decentralized approaches.

The institutions themselves, I think, need to take up the challenge to be inventive. Policies ought to allow creativity and imagination. I think it is extraordinary what is going on now in the relationships between universities and industries—not only universities, by the way, other educational institutions as well.

We need to encourage that and I think some tax incentives should be considered, both from the Federal level and the State level, perhaps even the local level—cities now have a lot of taxes that hit industries pretty hard. To encourage industries to work with educational institutions would be very desirable, but the institutions themselves have got to get a little greater sense of commitment and a little greater momentum.

It is building up quickly, I would say.

Mr. **Dymally**. Thank you.

Dr. Bottoms, especially in Congress and State legislatures, we find the emphasis on the one hand on jobs for young people; on the other hand, we find emphasis for jobs for senior citizens. There is a big gap in the middle.

Do you have any suggestion as to how we could have a broader perspective about this whole question of jobs, retraining and training for all age groups, so to speak?

Dr. **Bottoms**. The 3 million individuals who are currently enrolled in these institutions that provide vocational programs are roughly of the average age between 29 and 30. You are pulling very heavily off of that middle bulge now where you have an awful lot of folks. I think we are going to increasingly see increasing numbers of individuals who are employed and unemployed in that age range, seeking retraining as a means to begin to move a step up the ladder.

I think I was suggesting that what we have got to make sure is that we have the institutional capacity in the community to offer programs that are, in fact, on the cutting edge of the workplace in one sense. It seems to me that a number of States for many, many years, and now I see many of the old industrial States moving in the same direction, have for a number of years linked their vocational and training programs directly with economic development growth, and have purposely tried to use those institutions to provide a service to employers to help upgrade their existing workers.

There are States that have, you know, 90 to 100 persons out of every 1,000 population each year enrolled in a vocational technical program. There are States that have as few as 15 to 20.

If one begins to analyze those States, you find that the States which are hardest hit today are the States that are doing the least amount of adult vocational education at the post-secondary level.

I think that we have to look at Federal policies and resources that tend to encourage the States to link the vocational technical effort to economic development, to intervene earlier in the unemployed, to assist those that are not likely to go back to their old jobs, who are not likely to get a job unless they acquire some skills.

I do not know why we have to wait 50 weeks, 60; I am told that in 10 or 15 weeks, we pretty well know who the individuals are who are going to have the most difficulty. Why cannot we begin to encourage some retraining efforts there?

We would propose in the reauthorization of the VocEd legislation an adult title that would particularly concentrate dollars to utilize this network of institutions, to retrain adults, and in particular to assist the smaller employers that do not have in-house training capacities to help upgrade individuals.

Mr. **Dymally**. Thank you very much, Mr. Chairman.

Dr. **Swain**. Mr. Chairman, may I add just one brief comment?

Mr. **Gephardt**. Sure.

Dr. **Swain**. Mr. Dymally, there is an additional point I wanted to make in response to your question if I may. That is about the Federal role. Let me say again that we need flexibility, and perhaps on a targeted basis, some additional funding, but in general—and I could not underline this enough—what the Federal Government could do to help us greatly would be to provide up-to-date equipment. This is the most difficult task of all because of the pace of change in technology. Educational institutions of all varieties strain to obtain equipment on which to train their students which is up to date with the equipment that will be worked on when they get out into the work force.

If you have that level of disparity, training on obsolescent equipment, your students, when they get out—no matter whether you are talking about Ph. D. students or high school students or vocational students—are at a great disadvantage. Local and State governments are simply not able to do that.

I think that is a classic case where the Federal Government might well step in.

Mr. DYMALLY. Mr. Chairman, I think Dr. Levin wants to add something.

Dr. LEVIN. Right. I did want to respond because when I think of when an RFP comes for youth to a group, then they design—where there are funds—a program for youth. When there is an RFP for people who are displaced, the program gets designed for them.

I think what would be tremendously useful and would stimulate some programs of vision would be to develop an RFP for all the different segments of the population that needed retraining on, to take one industry. It would force people to think what happens after 2 years. What happens to people who start at the lowest level of skill? To really force us who design programs to try and think of lifelong education and work and to give out money for something that had some vision and come up with more imaginative solutions.

Mr. DYMALLY. Thank you.

Mr. GEPHARDT. Representative MacKay.

Mr. MACKAY. Thank you, Mr. Chairman.

I am interested in going back to a topic that was touched on in last Thursday's hearing in which one of our witnesses, in response to a question, said that he did not see any correlation between high school vocational education or secondary level vocational education and subsequent employment.

In other words, in his opinion, it was a mistake to offer vocational education at the secondary level. We should be concentrating our efforts at a postsecondary level. That troubled me a great deal. I kind of made a note to catch Dr. Bottoms and some others who are in this business.

The thing that bothers me is that about 25 percent or more of our high school students are dropping out of high school. They are clearly the high-risk people in our society. They are high risk from society's standpoint in the sense that they are not trained. If you had to select who is going to be the unemployables, there would be a very high correlation. The correlation between the other statistics would also be very high.

The more you look at that group as a target group, the more you see that you really are not serving them. Counseling or guidance is not set up to meet the needs of a young person who is not going into postsecondary education. Vocational educational programs generally start after age 16, which is the age at which they have already dropped out, and we do not provide job placement for anyone except those who succeed, who, by definition, probably need it the least, the college graduate.

Now, it seems to me that if you are going to relook at the Vocational Act and the Federal role, perhaps we ought to be taking a look at what the Federal Government could do for that high-risk population. We are almost building a program under the assumption that we are going to keep on failing because we are talking about what we need to do is we need to learn how to educate adults who cannot read and write, which means we are assuming that whatever we do is not going to work for that 25 percent until they are out and have failed.

That is a fairly broad statement of a problem which I see as a very intense problem. What I want to know is, who is responsible for that? Is that the responsibility of the vocational educator? Should the Federal Government, in trying to decide what its role is in the future, be paying attention to that?

Dr. BOTTOMS. Congressman, we feel that if, at the point we enroll a student in a vocational program, one of the barriers in preparing that individual for employment in particular occupational areas is their lack of basic skills, we have an obligation to provide that individual with the basic skills along with the occupational skills.

You will find that many of the specialized vocational centers across the country increasingly are keeping these students for longer periods of time, have added related teachers in both reading and math and even science to teach this in direct relationship to the occupational area.

Now, when you take a student at the 10th grade level who comes to you reading at the 5th grade level, it takes more time to teach both the basic skills and the occupational skills. It takes more hours of the day. It takes a longer period of time.

One of the things that we would like to see in reauthorization of the VocEd legislation is particularly a compensatory time to focus that in which the Federal role would be to assist the States to pay for the extra kinds of services it is going to take to take that 25 percent we are talking about and raise their productive capacity.

Now, in terms of secondary vocational education, we work both with secondary and postsecondary institutions. The one study that has really stood out has taken the high school transcripts of about 12,000 individuals and begun to follow them over a period of time. It clearly shows that students who have had an intensive and concentrated program in secondary vocational education do, in fact, have an advantage in the job market.

Sometimes, you do not know whether they have had a 1-hour course or 2 years at 3 hours a day with the appropriate related math and science. Most people—and the NIE study pretty well concluded that those students who are in the more specialized secondary vocational centers have no difficulty in making the transition; in fact, have a leg up.

Those in the more general institutions tend to have the weaker programs. We have been trying to concentrate on the general institutions to look at ways to strengthen that particular effort.

Mr. MACKAY. Can you see, then, that—are you saying that the idea of introductory, almost like prevocational programs in the seventh, eighth, and ninth grades, are not proven to be useful? It seems to me that was the whole assumption to which here was a major thrust over a number of years.

Dr. BOTTOMS. I basically am saying that the evidence seems to suggest that if the students only get in the 11th and 12th grade an hour's program in vocational education, they really do not get enough depth to get a skill. Therefore, they seem to have no more of an edge in the labor market than students who did not take the 1-hour program.

Those students who get concentrated preparation in a 3-hour block with related support and subject matters, they definitely have an edge in the marketplace. Twice the number of those students—6 percent of those students are self-employed, as opposed to 3 percent of the high school graduates in general.

Mr. MacKay. Well, I agree with that, but that sort of says that you do not necessarily think that is the responsibility of the vocational educator for the student who is going to drop out of high school. What I want to know is whose responsibility is that?

Dr. Bottoms. I think it is the public education responsibility, Congressman, including vocational educational responsibility. I guess what I was—of course, part of my answer was trying to say, it will take an extra effort to take those students who are going to drop out. It will take more time; it will take more resources. When you—it is kind of like the gallon and the half a gallon problem. You have got a half gallon's worth of resources, and a gallon's worth of needs. Where do you concentrate?

That is one of the problems that we are confronted with. We would like very much—many times we get students in secondary vocational programs without the resources to teach the related basic math skills and science skills. They cannot read the manuals. All you can do is teach some manipulative skills.

The evidence is quite clear where you do that. Those students have some major barriers in moving up the job ladder.

Where we have been able to get funds for dedicated reading and math instruction for those students, we have seen some tremendous jumps in those students' achievement because you can, in fact, use the occupational content and objective, both to teach the math and reading.

That is what we would ask that one of the Federal roles be to help assist. For example, in the set-asides of the current VocEd Act, for the disadvantaged, that comes to $50 for every disadvantaged student enrolled in VocEd. That is how much that money comes to.

Under ESEA, for the elementary school students in math and reading, to help the poor student there who is behind, that comes to almost $500 per student. If we had that kind of resource base to get these students in high school, we could make some progress with them.

You cannot teach the traditional English, math in secondary schools where a lot of these students simply will not work. You have to begin to refocus those programs.

Mr. MacKay. The other comment that I would—Mr. Chairman, if I am not going too long—I would like to pursue the suggestion that was made that we look at programs in States like Oklahoma, South Carolina, and others, where they have linked their postsecondary vocational effort, at least in part, to the job market. They have said it will be driven by the employer demands. When the employer says I need 500 people for a new plant, the State, in effect, owns the equipment or leases the equipment and goes in and sets up the program. In Florida, that is called industry services training.

Are there disincentives or are there things in the statute now to keep that from being expanded more rapidly? It would seem to me that is a model that is somewhat like Dr. Levin's model.

In other words, it seems to me that perhaps in a way we are evolving in that direction. I would like your comments.

Dr. **Bottoms**. Congressman, the 16 States we surveyed all were using that kind of approach to connect expanding job opportunities to retrain folks for those, using the kind of model you described.

Most reported that the money they had allocated for that purpose would run out in the middle of the year. They simply have to turn down opportunities throughout the year.

We feel that we need, particularly in that field, a dedicated authorization for that kind of purpose so that the Congress can, in fact, appropriate money that will be dedicated to that activity.

We would be glad to share with you some kind of language and hopefully the House will get an opportunity to deal with the new VocEd bill in the next few months.

Mr. **MacKay**. Dr. Levin.

Dr. **Levin**. I think that my idea is a little bit different. I am not opposed to programs having some stimulus, being driven to some degree by the employer's needs, but I think that there are other needs that we overlook. When they are just driven by the employer's needs, we often get these short-range, quick-fix programs that do not really develop human potential. The human need is certainly overlooked. The potential contribution of the workers, as well as the employer, to the educational plan and program would provide an important balance.

Dr. **Swain**. Mr. MacKay, may I make a point?

Mr. **MacKay**. Yes, sir.

Dr. **Swain**. I have given some thought, too, to the question of vocational training. I think, in the last 15 to 20 years, we have made a large mistake in thinking that by substituting vocational training for students who have academic difficulties we are solving that problem. I think the research shows that is not working.

If you have students who have learning difficulties and they are not reading well, that may well be the reason they drop out. They are not understanding. They are bored and their self-esteem is way down.

I think we should not substitute vocational training for basic skills training if that is, in fact, the problem. I certainly agree with Dr. Bottoms that if you do not teach a student who drops out of high school how to read, he cannot even benefit from future vocational training.

So I think one should not substitute vocational training for basic skills learning, even for students who are on the brink of dropping out. That is the fundamental problem and I do hope we can focus on it in the future. I think that will be necessary.

Mr. **MacKay**. Thank you, Mr. Chairman. If we have time, I would like to come back and pursue one of these.

Mr. **Gephardt**. I just have a couple of quick questions. One, do you feel that we possess sufficient information about the kinds of skills and the kinds of jobs that are going to be demanded in different parts of the country so that the educational retraining/training programs are as successful as they could be?

If you think that we do not have sufficient information, can you tell me who you think should develop that information, at what level of government or at what level of the private sector?

Dr. **Levin**. I think we have sufficient information to know some of the directions, for example, computer science. A basic understanding of computer programing, even as the field changes, will provide a broad educational base that a person could still use.

Dr. **Swain**. Mr. Chairman, may I suggest that, I think, given the pace of change, it is virtually impossible to have detailed and very precise information about the kinds of jobs that next year or the year after will be needed and how many of them. What we need, though, is more sophisticated and comprehensive studies of trends. If we are able to project trends a few years in advance, we can stay ahead of the process.

I think further, in considering retraining and training, we need to understand that ultimately we should retrain people less narrowly and have retraining programs which can be fairly broad in their application.

People are going to be needing retraining repeatedly, probably, because the pace of change is so rapid. So, understanding trends—what is happening in automated and manufacturing processes, what kinds of jobs flow out of that change in our economy—that kind of trend analysis. We do not have this at the moment and we need it.

Now, I think that could be done at the Federal level. I think it would be very useful for national analysis to be done of this, but in the end, you also have to have regional analyses and you have to fine tune this down to the local jurisdiction.

I think ultimately you would need some research at all of those levels and I would think that the Federal agencies could do the research at the Federal level, but at the regional and local level, research agencies like universities could certainly help.

Dr. **Bottoms**. I would just simply look at the Federal level. I think agencies like the National Bureau of Labor Statistics ought to have increased capacity to look futuristically at these trends and at what the implications are. But I would couple what—much of our efforts to project forward occupational information is based on historical data. That is, we try to manipulate that data.

What it seems to me that we need to temper that with is a series of very decentralized studies in different regions throughout the country to really find out how new jobs are occurring and what the requirements of those jobs are.

That is the kind of information you have to have to begin revising curriculum and curriculum development and, hopefully, any Federal effort would be tempered with a whole series of decentralized studies. You begin to bring the person who manages the local plant, a variety of these, to look at data in the real world.

Increasingly, we need to find ways to encourage institutions and employers in local communities to come together to look at curriculum in terms of the requirements of the workplace. That is a very valid process to make sure that curricula are, in fact, valid in the skilled and technical areas.

Mr. **Gephardt**. How do you do that now?

Dr. **Bottoms**. You have—some institutions that we have been working with recently, particularly in engineering technologies, we ought to invite in a series of employers in the community whose companies or plants are in the advanced technology area and have them begin to take a look at what we think is an appropriate curriculum. If you get an individual who has this knowledge base, can do these kinds of things, is this the kind of individual you can use?

Many times those run for a couple of days, kind of back and forth. You make revisions and you go back to the companies to try to get that done.

We also—most of our institutions do use a set of local advisory committees in that regard and a number of States do, in fact, fund some occupational update kind of studies under the Federal legislation.

Mr. **Gephardt**. I guess my feeling is that we have done it on a pretty unscientific basis. I am not criticizing; I am just stating what, I think, is a fact. My hope is that we can do a better job nationally, and regionally, and locally of developing better information.

I know that in some areas, they are trying to do this. Some States have commissioned studies, as you have said, and tried to develop better information. To me, this is a critical question and we can waste an awful lot of time and money if we do not know what we are doing.

It seems to me that while you cannot exactly pin it down—I recognize that—it seems to me that doing a better job of looking at the trends would give us a much better idea of where we are going and how we are going to do it.

That really runs into the next question and that has to do with equipment. Most of you said you need equipment and you need Federal money for equipment.

The economy is changing and products are moving off the market and new ones coming on faster; skills are changing faster. All the testimony we have heard indicates that the demand for skill change is accelerating; we will need more retraining throughout the adult life.

The question occurs: Are we getting to a point where specific equipment-related education is going to have to take place in the private sector and will we have to rethink what we are doing in universities, and in vocational education programs, and in schools because of the quickness of the change of technology and the demands for change in skills?

I have been out to vocational schools in St. Louis and talked to them. They say the same thing you say. Our equipment is out of date. We are 4 years behind. The state of the art is way beyond us, and we are training people on things that are just not useful.

When you talk to the private sector, they say the change is so rapid, even if we could get the machines out there, it would still be too late. We have enough trouble in our own factory getting the right machinery in place.

Is the pace so quick that we have got to rethink what we are doing in terms of classic vocational education, et cetera?

Dr. **Swain**. Mr. Chairman, if I may, I have a thought on that. I did state in my testimony that we need to make the concept of retraining fresher, in that people ought to expect it and it ought to be part of our education starting very early on.

It does seem to me that in Louisville, Ky., the employers are more and more expecting to do their own training and retraining. What they want is people they can hire who have the basic capacities to be retrained.

In that sense, they are already responding in, I think, the way you are suggesting. If a bank gets new technology—or a manufacturing firm—they will quickly retrain their own employees to use that new equipment if the employees have the basic skills and conceptual understanding to be retrained.

My point about equipment is that even at universities, our equipment lag is so far out of date that it does not allow us even to bring some of our students up to a level of basic skills proficiency. I am sure the same thing must be true in vocational training. We do need to have help with equipment that will allow us to get our students up to some basic level of understanding of the basic technology; understanding the rudiments of the technology they will be dealing with, but not all of the specifics of every new generation of machine.

The employers will do that. But I do think there is a problem on equipment. You cannot be teaching students these days on a 10-year-old computer. They really will not be able to relate to the computers that they are going to work on in a bank, for example.

We have got to have a computer that is more up-to-date than that, but basically once you get a computer within 4 or 5 years of the current generation of computers, you are dealing with something that the students can then use as a basis from which to translate their skills.

Dr. **Levin**. I guess I am very worried, even though I know I have to work with industry, even in this program I described with machinists, there is no way that we can get robotic equipment into any of our schools. It is absolutely too expensive. But I feel that I would not want to be totally dependent on industry. We have to work cooperatively with the industries that these machinists come from where they are using robotic equipment and certainly give them something in return.

Just as I would not want one industry to be doing the education of elementary school children, I just think there has to be a balance of points of view because robots can be used in many different ways.

Just because you have robotics does not mean that it will all go one way. There are different types of systems where the human can have more to do and use more of his skills or her skills or really be very deskilled in the use of robotics.

I think that these things are not only important in terms of the individual workers, but they are important in terms of society because the long-term consequence is greater alienation.

We have to think what are the side effects and long-term consequences of this kind of training. So, I do think we must work with industry cooperatively, but there have to be other parties—the users—in this exchange who have something to say.

Dr. **Bottoms**. I will agree that we have to work cooperatively with the employers and, to the extent possible, use the employment setting for some preparation purposes in some of these advanced technologies.

Where we have difficulty is when the new technology dramatically alters the kinds of skills and techniques that are used in the workplace. It is in those programs where we need help in retooling.

I do not think we are talking about all manufacturing scale equipment. You can purchase miniature versions of the small robots that have all the basic principles there that huge industrial robots would have. It is important that we have the miniature version so that you can at least begin to understand all the different systems that make up that piece of advanced equipment.

Mr. GEPHARDT. I thank you all very much. Your testimony has been excellent and we appreciate your time.

Representative Simon is here and he may have some questions.

Mr. SIMON. Just one question. I agree with the general thrust of your in-and-out here. I have had a chance to go through your testimony. The one area that disturbs me really is a more basic area.

I am from an area of high unemployment in deep southern Illinois. I have eight counties with over 20 percent unemployment. One of the questions I automatically ask people who come in during my open office hours and who want jobs now is: Can you read and write? Frequently, there is that awkward moment of pause because they do not want to admit that they cannot read and write.

Frequently—and these are people who are 35, 38, 40 years old, who do not have the most fundamental skills in our society, and it is nice to talk about retraining for high tech and a lot of other things, but when people do not have this, it really becomes tough.

These are people who have been able to get by. They are coal miners who can read a stop sign, and you know, there are some fundamentals that they can do, but they could never fill out a form to apply for a job; they cannot do all kinds of other things.

Any kind of response the three of you might have to what we do about this?

Dr. LEVIN. I think that is exactly what could be the negative of letting industry and its needs drive training, because those coal miners were driven by the need for coal, but they did not get educated. We can have robot operators not being educated, either. There are certain uses of high technology that will not bring in higher skilled people, but deskill or bring in lower-skilled persons. This is a great danger.

I think that is why we have to have some input from higher education, from people who have other values than just production for profit.

I agree with all the other things that have been said, too, about how the primary education system has to address what they have not been successful in doing, for whatever reasons, for some time.

Mr. SIMON. Except—if I may just interrupt—these are people who would be embarrassed to walk into a grade school to learn how to read and write. Somehow, we have to devise—and this is why whether it is community colleges or the University of Louisville or local libraries or what, we have to devise a socially acceptable way for people to take this hidden liability and get rid of it.

Dr. SWAIN. Mr. Chairman, I agree with that point. In fact, I would suggest that there are two parts to a strategy to solve the problem you are referring to. I think it is a fundamental problem.

One is the long-term strategy, and I think we should start upon it right away. That is, to make certain that more students get through our public school system who are literate. Whatever it takes, we need to do it. The stakes are extremely high in our society on that basic point.

Second, we cannot ignore the people who have been through our school systems and still are not literate. We need, also, a shorter-range strategy to deal with the surprising, the shockingly large portion of people in our country who are functionally illiterate.

There we need special programs. These should be basic-skills programs devoted to adults. Quite often they can be piggy-backed on technical retraining programs where people have high motivation to be retrained. If there is a job available, they can be highly motivated to learn to read.

Bringing those two together is probably a good thing to do, but there ought to be places, I agree with you, where adults who are, say, 40 years old, can come and not be embarrassed and learn how to read.

We do not have those at the moment. That is something we need.

Dr. BOTTOMS. Congressman, certain basic skills or fundamental job skills today, to the extent that one can connect the teaching of basic skills and job skills to the kinds of adults we are talking about, that seems to make an awful lot of sense.

The evidence seems to suggest that the kind of adults you are talking about may feel more comfortable at institutions closest to their residences. One of the problems I know that we are having in some of the States in the Midwest is that where they have cut back local funding, and particular vocational programs, there has been a cutback in keeping those facilities open for adults.

They made their first commitment to keep them open for the in-school youth, full secondary youth, where they have had to cut back.

But one of the problems in addressing this problem of retraining is having the doors open to serve adults.

Mr. SIMON. Thank you, Mr. Chairman. Thank you very much.

Mr. GEPHARDT. Thank you all for being here and spending your time with us. You have been very helpful. Thank you.

Mr. GEPHARDT. The next panel is on the same subject of training and retraining. We have Charles Keffer, president of educational operations of Singer Co.; we have Avril Madison, executive director of Wider Opportunities for Women; and we have Robert Finnell, who is executive director of mathematics, engineering and science achievement program, University of California at Berkeley.

We are going to begin with Mr. Keffer from the Singer Co. Welcome.

[The biographical sketch of Mr. Keffer follows:]

CHARLES F. KEFFER

125 Ramhorne Road
New Canaan, CT 06840
Home: (203) 972-1016
Bus.: (203) 356-4200

summary Fifteen years of general management experience with emphasis in marketing and product development; also division controllership, plant management and planning.

experience THE SINGER COMPANY, Stamford, CT

A $2.7 billion international multi-industrial corporation.

1977 to present President - Education Division

A diversified $100 million division of Singer. Managed all facets of three fully integrated operations. During five years in this position, increased sales from $60 million to $103 million generating operating income in excess of $5 million. This division consists of three diverse vertically integrated businesses: a service business (training), a manufacturing and distribution business (projectors), and communications (instructional materials for schools).

1974-1976 President - SVE, a wholly owned subsidiary of Singer

Increased sales from $8 million to $15 million in this high margin operation which produces, publishes and markets instructional materials. Marketing was conducted through a combination of a proprietary sales force, catalogs and direct mail.

1970-1973 Vice President, Planning - Education & Training Group

A $250 million Group consisting of the high tech Link Division and four education businesses. Responsible for planning, with emphasis on product development and marketing. Each business was broadening its base and the Group doubled in size during this period.

JOSTEN'S, INC.

1965-1969 Division Manager - Commercial Division

Responsible for marketing, planning, product development, and financial functions. Started this division for Josten's by adapting its outstanding school product lines to programs needed by business and other organizations.

1962-1964 Plant Manager - Princeton IL

Built and managed 60,000 square foot manufacturing plant. In addition to responsibility for manufacturing school rings and jewelry, served as product manager for the Awards Division with responsibility for product line P&L, catalog development, and customer service; a two million dollar business in addition to five million dollars worth of ring manufacturing.

1960-1961 Division Controller - Awards Division

A turn-around situation. Josten's acquired a losing operation which we made profitable through a combination of cost reduction, adoption of new catalog concepts and implementation of a new marketing program for the field sales organization.

education HARVARD BUSINESS SCHOOL 1958-1960

MBA in Business Administration

UNIVERSITY OF MARYLAND 1951-1955

BA in Political Science, minors in Economics and History.

military U.S. AIR FORCE 1955-1958

Lieutenant in Air Traffic Control

personal Married; 5 feet 10; 170 pounds; excellent health

STATEMENTS OF CHARLES F. KEFFER, PRESIDENT OF THE EDUCATION DIVISION, SINGER CO.; AVRIL MADISON, EXECUTIVE DIRECTOR, WIDER OPPORTUNITIES FOR WOMEN; AND ROBERT A. FINNELL, PRESIDENT, NATIONAL ACTION COUNCIL FOR MINORITIES IN ENGINEERING, INC.

Mr. **Keffer**. Thank you very much.

Thank you for the opportunity to meet with your committee. Today, I would like to talk about three things: First, to tell you about the Singer Co., because our experience is applicable to the problems you are discussing; second, to tell you about Singer's experience in Job Corps, because Job Corps is a program that works; and third, to tell you about one particular phase of the Job Corps program that is especially effective and is applicable to other programs that you may consider, and that is the assessment and counseling area.

First, to tell you about the Singer Co.

The Singer Co. is a microcosm of U.S. industry in many ways. The company was known for years as the sewing machine company. But that traditional business fell off. The market changed, trends changed, less sewing was done in the home, and foreign competition came in to affect the business significantly.

So, the Singer Co. undertook one of the most fundamental redirections ever by a U.S. corporation. The company was steered onto a new course; high technology became the focal point of the strategy of growth for the company. R&D and capital spending and other resources were diverted primarily to the high-tech activities.

And these activities include things like simulation, inertial guidance, weapons control systems, computer specialized systems. For example, the Link simulators from our company were used to help train the astronauts and so on.

Now, sewing today is less than half of the Singer Co.'s business. On the other hand, high tech has more than doubled in the past 5 years, and now makes up more than 40 percent of what we do.

Singer is a diverse company. It has 15 divisions, employs nearly 60,000 people. That is down from nearly 80,000 just 5 years or so ago.

We have 56 major manufacturing facilities in more than 30 countries. And in addition to sewing and aerospace, we have divisions in education, in power tools, gas meters, controls, furniture, home appliances.

So it is a diverse company shifting over to high tech.

Now, in the education division, of which I am president, we design and implement a wide range of training programs, but our primary business is the Job Corps program for the Department of Labor.

We conduct other programs in career exploration, in assessment, in vocational and technical training, and we do this for the Government, for industry, for the military, and for other customers around the world.

Singer has had more experience in Job Corps than any other private-sector contractor. We now operate a dozen Job Corps centers around the United States.

The Job Corps program was created in 1964 and Singer got into the program in 1966, and has been in it since then, and that program, as you know, helps disadvantaged young people get into the mainstream of American life as self-sufficient and responsible adults.

The program has always enjoyed bipartisan support and it has been effective. Since its beginning, Job Corps has introduced and perfected many methods of teaching and training for these young people aged 16 to 21, and the approach is successful, as demonstrated by the high percentage of graduates who go onto further schooling, who get jobs, or who qualify to go into the Armed Forces, where they would not have so qualified before entering the Job Corps program.

Job Corps programs are largely residential in nature. They vary in size from a couple of hundred enrollees to more than 2,500 enrollees in a particular center. The fundamental idea is to provide a new living and learning environment for the enrollees.

They also receive other services such as health and dental care, nutritious meals and decent living quarters, which differs from the environment from which they generally have come to get their education and training.

A key factor is that a Job Corps enrollee moves at his or her own pace; and second, the Job Corps program is adaptable. It is an open entry, open exit program.

One of the first steps in training is to lead the person to a personal discovery about goals and about interests, about aptitudes and about abilities. This self-assessment helps the trainee find direction for selecting training that would be productive and rewarding.

At the outset, a Job Corps enrollee is given the opportunity to engage in hands-on activities, to explore and evaluate job requirements. All Singer-operated centers use a program called the Singer vocational evaluation system, which is made up of individual work stations, tools, and tasks that cover over 3,000 occupations, and they rely on audiovisual instruction.

Brochures on this system can be made available to you if you are interested in that.

Once the person has gone through this self-assessment, then they go into curriculum areas as diverse as either clerical or building trades, metal trades, health, electrical and electronic, automotive trades, and many others. A more complete list is provided for you.

Training is also provided in support areas, such as consumer education, health education, driver education, because that is needed for many jobs, and also intergroup relations.

Programs also help the corps members with job hunting and placement, in getting along with people both on and off the job, and in adapting to the community in which they live.

Singer's commitment to Job Corps has been longstanding and it is ongoing, and we have applied many of the things from Job Corps, many of the principles to other training applications.

As far as assessment and counseling are concerned, because these have worked well in Job Corps, Singer has conducted a number of separate career exploration and assessment projects.

We have conducted programs for the displaced and disadvantaged adults in Mississippi; we have worked on programs for correctional institutions in Illinois; hardcore unemployment programs in New York State; several other programs in New York State.

We have worked programs in Montana; for counseling and training and placement of welfare clients, primarily Indian women. We have worked a number of other programs: CETA assessment programs in Memphis, Nashville, Phoenix, Oklahoma City, Atlanta, and many other cities.

Now, as far as high tech is concerned, at the beginning of this presentation, I mentioned Singer's growth in high tech. We have hired and trained many people. As an employer in high tech, we pay a lot of attention to upgrading of skills.

Our employees are encouraged to take advantage of company-sponsored programs to learn these new skills and to keep current with the existing skills, and we expect to do that as a high-tech company. We expect to do it and pay for it.

From the public sector, what we need is entry-level engineers and technicians who have a good basic education and who are trainable and motivated. High-tech companies will do their own training and can buy outside services to handle the higher level of skills that are required.

We do not look to the public sector for this upgrading. We do look for a tax environment which would continue to encourage us to do this. We have a need and are self-motivated to make sure that this training occurs.

Assessment also relates to dislocated workers, and we are beginning to work in this area. Dislocated workers are growing in numbers, and they need jobs, and we are applying our assessment and training programs to these areas.

An unemployed steelworker has no desire, though, to go through a special training program and then become an unemployed computer operator. Training in a popular field is not enough. The geography is also important, and the jobs in these popular fields must be available in the right geography for workers.

So, just as in Job Corps, where effective surveys are made ahead of the fact, to make sure we are training people for areas where there will be jobs will also be important for dislocated workers.

Time Magazine's May 30 issue listed the 10 best prospects for jobs in 1990. They said that these jobs would be secretaries, nurses' aides, janitors, sales clerks, cashiers, nurses, truckdrivers, fast-food-workers, clerks, and waiters.

The point seems to be that the growth over this decade will be in service-related occupations. Many of you who are involved in these hearings on technology in employment may become discouraged when you see that the jobs that are growing seem to be service-related, but I would hasten to point out that a company interested in growing in high tech, the preponderance of our employees will not be Ph. D.'s; the preponderance of our employees will be in these so-called service-related fields. They also will need skill training and upgrading, and they will need assessment and counseling to make sure that they are getting the training in a field that is practical for them.

I will end this presentation with the three points where I began. Singer and other companies must change with the trends, and we are changing. Federal policies need to encourage this kind of change.

Second, Job Corps is an effective program with some lessons that will apply to other training efforts, and we should learn from the successful programs that have been operating.

And finally, assessment and counseling will be an important factor in any training program to be sure that we are training for skills where the jobs are needed.

Thank you very much.

[The prepared statement of Mr. Keffer follows:]

Statement of
Charles F. Keffer
before the
Subcommittee on Science, Research and Technology
of the Committee on Science and Technology
and the
Task Force on Education and Employment
of the Committee on the Budget
U.S. House of Representatives
June 15, 1983

Thank you for the opportunity to meet with your committee.

Today, I want to do three things:

1. tell you about the Singer Company because our experience is applicable.
2. tell you about Singer's experience in Job Corps because Job Corps is a program that works.
3. tell you about one particular phase of Job Corps that is especially effective and is applicable to other programs you may consider --- and that is Assessment and Counseling.

THE SINGER COMPANY

The Singer Company is a microcosm of U.S. Industry in many ways. The company was known for years as the sewing machine company. The traditional business has fallen off, however. The market changed and trends changed. Less sewing was done in the home and foreign competition increased significantly.

The Singer Company undertook one of the most fundamental redirections ever by a U.S. corporation. The company was steered on a new course.

High technology aerospace has become the focal point of Singer's strategy for growth. Research and development and capital spending have been focused on high-tech activities. These activities include simulation, inertial guidance, weapons control systems, and signal processing and analysis systems. For example, the Link Simulators which were used to train the astronauts were made by Singer.

Sewing is now less than half of Singer's business. High-Tech businesses on the other hand have more than doubled in the past five years and account for about 40 percent of the total sales of the company.

Singer has 15 divisions, employs nearly 60,000 people and has 56 major manufacturing facilities in more than thirty countries. In addition to the sewing and aerospace businesses, Singer has divisions in education, power tools, gas meters, controls, furniture and home appliances.

SINGER AND JOB CORPS

The Education Division designs and implements a wide range of training-related programs. Job Corps training is the largest component, serving the U.S. Department of Labor. We also conduct programs in career exploration, assessment and vocational/technical training for government, industry, military and other customers worldwide.

Singer has had more experience operating Job Corps centers than any other private sector contractor. Created in 1964, Job Corps began a pioneering program to help disadvantaged young people enter the mainstream of American life as self-sufficient, responsible adults. The program has enjoyed bipartisan support and has been very effective. Singer got into program operations in 1966.

Since its beginning, Job Corps has introduced and perfected many new methods of teaching and training to meet the special needs of youth aged 16 to 21. That the approach is successful is demonstrated by the high percentage of graduates who go on to further schooling, get jobs, or qualify to join the armed services.

Job Corps centers are major training operations. They range in size from several hundred to more than 2500 enrollees. Most centers are coed, emphasizing residential training. A fundamental idea behind Job Corps is to provide a new living and learning environment for the enrollees. Basic services such as health and dental care, nutritious meals and decent living quarters have to be made available. In education and training, each person is given an opportunity to progress at his or her own pace within the time frame of the overall program requirements. Open-entry-open-exit is a key feature.

One of the first steps in training is leading the person to personal discovery about goals and about interests, aptitudes and abilities. Such self-assessment helps the trainee find direction to select training that will be productive and rewarding. (Singer has applied these assessment skills and experiences to many programs outside Job Corps as well.)

Basic education is another foundation of training in Job Corps. Deficiencies, especially in reading and mathematics, have to be corrected before an enrollee can make solid progress in a vocation. Moreover, evidence of achievement in academic areas helps enrollees in meeting job qualification requirements.

At the outset, a Job Corps enrollee is given an opportunity to engage in hands-on activities to explore and evaluate job requirements. All Singer operated centers use the Singer Vocational Evaluation System comprised of individual workstations, tools and tasks related to over 3000 occupations and audiovisual instruction. Brochures on this system can be made available to you.

The vocational courses themselves span a wide range of skills, including:

- Clerical
- Building Trades
- Metal Trades
- Health
- Culinary
- Horticulture
- Retail Sales
- Repair Mechanics
- Electrical and Electronics

- Data Processing
- Heavy Equipment
- Building Maintenance
- Graphics
- Automotive Trades
- Drafting
- Needle Trades

Training is also provided in supportive areas such as World of Work, consumer education, health education, driver education and intergroup relations. Programs help corpsmembers in job hunting and placement, in getting along with people both on and off the job, and in adapting to the community in which they live.

Singer's commitment to Job Corps has been longstanding. It will be ongoing. Singer has applied many principles developed for Job Corps to other training applications.

ASSESSMENT AND COUNSELING

Because assessment programs have worked so well for Job Corps, Singer has conducted a number of career exploration and assessment projects for others. Among our clients have been:

- displaced rural and disadvantaged adults in Mississippi
- an Illinois Youth Commission project for correctional institutions
- hard core unemployed in New York State
- a work study and dropout prevention program in New York

- an evaluation and placement program for parolees and inmates in New York State
- two projects in Montana for counseling, training and placement for welfare clients, primarily Indian women
- an evaluation and assessment program for rehabilitation clients, many of whom were industrially injured and had to change careers
- a full assessment program for 2400 CETA clients in a turnkey operation in St. Louis
- CETA assessment programs in Memphis, Nashville, Phoenix, Oklahoma City, Atlanta and many other cities.

HIGH TECH TRAINING

At the beginning of this presentation, I mentioned Singer's growth in high tech. We have hired and trained many people. As an employer in high tech, we pay a lot of attention to upgrading of skills. Employees are encouraged to take advantage of company-sponsored programs to learn new skills and to keep current with existing skills.

From the public sector, we need entry level engineers and technicians who have a good basic education --- people who are trainable and motivated. High tech companies will do their own training and can buy outside services for these higher level skills; we do not look to the public sector to do this upgrading.

ASSESSMENT AND DISLOCATED WORKERS

Dislocated workers are growing in numbers. They need jobs. They need assessment and training and placement programs.

Singer's assessment and counseling experience is very applicable to many dislocated workers. The problems are often similar to those of the disadvantaged. Singer is adapting its assessment programs to the needs of dislocated workers.

An unemployed steelworker has no desire to go through a special training program to become an unemployed computer operator. Training in a popular field is not enough. Geography is important; jobs in those popular fields must be available in the right geography for the worker. Effective labor market surveys and effective assessment programs are just as important to dislocated workers as they are to the disadvantaged. Attitudes and aptitudes of the individual must be matched in the right job.

TIME magazine, May 30, 1983 listed the ten best prospects for jobs in 1990: secretaries, nurses aides, janitors, sales clerks, cashiers, nurses, truck drivers, fast-food workers, clerks, waiters. The point seems to be that growth is taking place in the service industries. Effective assessment programs will build awareness and understanding so that workers aptitudes, attitudes and needs will be matched with the best opportunities. Some of you who are involved in hearings on technology and employment may tend to resist articles and surveys like this because they emphasize the growth of service industries rather than high-technology. Most high-technology companies have a preponderance of employees who are not Ph.D.'s. These are service-related employees and they need assessment and counseling and training and retraining.

CONCLUSION

I shall end this presentation on the three points with which I began:

1. Singer (and other companies) must change with the trends.
2. Job Corps is an effective program with some lessons which apply to other training efforts.
3. Assessment and Counseling are especially important parts of any training program to be sure training is being conducted in the right area for the enrollee and for the job market.

ADDITIONAL WRITTEN TESTIMONY ON JOB CORPS

Job Corps is a major public program that attempts to alleviate the severe employment problems faced by disadvantaged youths in the U.S. These youths, especially those who live in poverty areas, have employability problems caused by their socioeconomic background. It embodies several factors related to age, educational level, behavior, etc., that limits the ability of young men and women to obtain and hold jobs. Youth employment problems, while always a serious concern, have recently become more severe.

The Job Corps approach is to provide a comprehensive set of services that include vocational skills training, basic education, health care, and residential support for young people who are poor, out of school and out of work with the aim to improve lifetime earning capacity by diminishing the cycle of poverty.

Job Corps is designed to serve youths who live in such difficult environments that they must be relocated to residential centers to benefit from basic education, vocational training and ancillary services. Education and training conducted in a supportive environment are the key elements in the program's effort to improve the employability of disadvantaged youths which, in turn, will help them become more productive and responsible citizens.

There are two basic types of Job Corps centers: those operated by private contractors selected in a competitive bidding process which is conducted by the regional offices, and those located on public lands (predominantly in national parks and forests) and operated by the Department of Agriculture or the Department of the Interior.

Recruitment and placement activities are carried out under contracts with employment service offices, various unions, local schools, volunteer agencies, in addition to efforts of individual centers and regional offices.

ENROLLEES IN JOB CORPS

Youths served by Job Corps are shown to be severely disadvantaged. Prior to enrolling in the program, the Corpsmembers have relatively low levels of education attainment and employment. In addition, they have relatively high incidences of welfare dependence and brushes with the law. The combined effect of the characteristics limits the ability of these young people to obtain and hold productive jobs.

A review of the socioeconomic characteristics of youths in Job Corps shows that:

1. Over 75 percent come from minority backgrounds - blacks, Hispanics, American Indians and Asians.
2. Between 85 and 90 percent of the Corpsmembers had not completed high school at the time they enrolled.
3. Almost all Corpsmembers had experienced difficulties in obtaining

and holding jobs; moreover, when they did find work, the jobs usually did not pay well. Over one-third of the enrollees never had a job at which they worked at least twenty hours per week and which lasted for at least one month. In the six months before enrolling in Job Corps, the typical Corpsmember was employed less than one-third of the time and averaged fewer than 12.5 hours per week at a wage rate of federal minimum.

4. Almost all Corpsmembers had experienced poverty, welfare dependence, or both; in the six months before enrolling in Job Corps, over 90 percent either had incomes that were below the poverty line or were receiving welfare assistance.

5. While many had attempted to enlist in the military, most of them failed to qualify.

TYPES OF SERVICES PROVIDED AT CENTERS

To help Corpsmembers overcome the problems highlighted above, Job Corps attempts to provide a comprehensive program that is flexible enough to meet the individual needs and problems of each disadvantaged youth. The components of the Job Corps program include remedial education, high school equivalency classes, vocational training, health care and education, residential living and counseling and other ancillary services, each of which is incorporated into a unified framework tailored to meet the individual needs of each youth.

EDUCATION

The Job Corps education program has evolved with the intent of meeting the varied deficiencies in the backgrounds of Corpsmembers and to enable them to proceed at the maximum pace commensurate with their abilities. This program includes remedial education (emphasizing reading and mathematics), World of Work (including consumer education, driver education, home and family living, health education and programs designed for individuals whose primary language is not English) and General Education Development (GED) for Corpsmembers who are academically qualified. The GED certificate is recognized by state educational agencies as the equivalent of a high school diploma.

VOCATIONAL SKILLS TRAINING

Like the education program, the training program at Job Corps centers is designed to meet individual needs and problems and to enable Corpsmembers to advance at the maximum pace commensurate with their abilities. Therefore, all the training programs provide for an open-entrance-open exit capability and are continually being reviewed and revised in order to keep up with the changing needs of Corpsmembers, as well as with the changing labor market.

Some work-experience positions are available upon the successful completion of training.

HEALTH CARE AND EDUCATION

Comprehensive health services are provided to all enrollees, including medical examination (with follow-up treatments, if necessary), immunization, dental examinations (for all Corpsmembers who stay at least ninety days) and dental treatment, professional help for emotional and other mental-health problems, and instruction in basic hygiene, preventive medicine, and self-care. Health education is also given high priority in Job Corps, with the aim of preparing Corpsmembers to make responsible decisions regarding health and health-related matters by providing them with relevant, factual information.

RESIDENTIAL LIVING

Residential living is a key component of the Job Corps program and distinguishes it from most other public employment and training programs. The concept behind residential living is that the target population comes from such debilitating environments that they need a new and more supportive environment to derive the intended benefits of the vocational training and education courses. The residential living program (including meals, health services, dormitory life, entertainment, sports and recreation, center government, center maintenance, and other related activities) is planned to help new Corpsmembers adapt to center life, motivate and support constructive attitudes and lifestyles, and prepare them to function effectively in the outside world. It also involves such complex areas as relationships among racial and ethnic groups motivation of alienated or discouraged young people, adaptation to unfamiliar group living situations, adult-youth cooperation in an institutional setting, and the role of peer groups in influencing conduct and attitudes.

COUNSELING AND OTHER ANCILLARY SERVICES

The centers provide counseling services and residential advisors both to help Corpsmembers plan their educational and vocational curricula and to motivate Corpsmembers and create a supportive environment. Some of the other support services provided by Job Corps (for example, during recruitment, placement, and the transition to regular life and jobs) were discussed above.

Mr. DYMALLY [presiding]. Thank you.

Dr. Madison? I suspect everyone knows about the rule and the lights.

[The biographical sketch of Dr. Madison follows:]

AVRIL JOHNSON MADISON

3731 Yuma Street, N.W.
Washington, D.C. 20016

Office: (202) 638-3143
Home: (202) 362-3321

EMPLOYMENT EXPERIENCE

DIRECTOR - Wider Opportunities for Women, Inc., Washington, D.C.
February 1983 - Present.

ASSISTANT DIRECTOR - Wider Opportunities for Women, Inc., Washington, D.C.
1980 - 1983. Development Specialist, 1977 - 1980.

- Assisted Executive Director in overall management, budgeting, administration and direction of a women's employment training and advocacy organization and its staff.
- Managed organization's development program, including: identification and development of funding sources; planning, coordination, preparation, presentation and negotiation of contract bids and grant proposals; and training of in-house staff in proposal and bid development process.
- Advocated women's employment concerns to policy makers and legislators at federal, state and local government levels. Planned and chaired policy meetings between national women's employment leaders and government officials. Routinely met with and represent organization to media, White House staff, Cabinet officers, Administration officials, local government officials and national, local and community groups.
- Developed and funded organization projects totaling almost a million dollars. Programs include: Suit Yourself...Shopping For a Job, a job finder's kit; Minority Deaf Women Employed; Displaced Homemaker Program; national Network Technical Assistance Project; Model Development Project for Women Offenders; SPEED (Rockefeller) Project; and Child Care Connections.
- Established and maintain working relationships with funding sources, including D.C. Department of Human Services, D.C. Department of Employment Services, Law Enforcement Assistance Administration, Community Services Administration,Women's Bureau, Aetna Life and Casualty Insurance, TRW, IBM, the April Trust, Third Sector Project and the Public Welfare, Queene Ferry Coonley, Meyer, Cafritz, Muskivinni, Rockefeller, Ford and Edna McConnell Clark foundations.

PROGRAM DIRECTOR - The Student National Medical Association, Inc., Washington, D.C.
1976 - 1977.

- Directed inovative national health education program which funded projects in 10 medically underserved communities across the United States.
- Developed and prepared RFP to solicit project proposals; supervised national competition; devised selection criteria.
- Supervised 10 selected project directors; provided technical assistance to projects; reported to national Advisory Board composed of government officials, educational, medical and corporate representatives.

AVRIL JOHNSON MADISON

ASSISTANT ADMINISTRATOR - The Student National Medical Association, Inc., Washington, D.C. 1973 - 1976.

- Coordinated day-to-day operations of organization's headquarter's office; managed financial operations of Association; assumed full decision-making responsibility in absence of Executive Administrator.
- Directed Association's membership program which served approximately 3500 minority residents, interns, and medical students; developed and produced membership materials including pamphlets, flyers, brochures press releases and news articles.
- Administered National Medical Preceptorship program; revised existing program to recruit a larger pool of medical practitioners and students; planned, developed and coordinated 10 regional outreach orientation conferences for program; moderated conferences.

PERSONNEL COUNSELOR - Distaffers, Inc., Washington, D.C. 1972.

FINANCE OFFICER - Rodgers Travel Bureau, Inc., Washington, D.C. 1969 - 1972.

RELATED ACTIVITIES

- Co-founder and member, Washington-Area Women's Funding Coalition, an alternative fund drive for women's programs. 1982 - Present.
- WOW Representative, Leadership Conference on Civil Rights. 1982 - Present.
- Member, D.C. Employment and Training Services Advisory Council, Mayoral Appointment, 1981 - Present.
- Member, National Society of Fund Raising Executives, 1981 - Present.
- Member, Coalition of 100 Black Women, Inc., D.C. Chapter, 1979 - Present.
- Former Member, D.C. Commission for Women, Mayoral Appointment, 1980 - 1982. Chairperson, CFW Task Force on Apprenticeship Programs.
- Former Member, Board of Directors, FOCUS/Widening Horizons Program of the D.C. Public Schools, 1979 - 1981.

EDUCATION

- B.A. Political Science, Case Western Reserve University, Cleveland, Ohio, 1960.
- Graduate School of Education, University of Denver, Denver, Colorado HEW Fellow, 1968 - 1969.
- "The Fundamentals of Fund Raising", institute sponsored by the National Society of Fund Raising Executives, 1981.
- "Coorporate Philanthropy", seminar sponsored by the NSFRE, 1981.
- "Grantsmanship", three month course at George Washington University, 1979.
- "Effective Speaking", three month course at Catholic University of America, 1978.

Dr. **Madison**. I thank you for the honorary degree, but I am Avril Madison of Wider Opportunities for Women, and I am here today representing both WOW and the 130 independent women's employment and training programs which are affiliates of WOW's women's work force network.

I commend both the chairman and the rest of the committee and their staff for the approach they have taken in planning such comprehensive and timely hearings, to discuss high technology and employment.

For inclusion in the hearing record, I offer the resources of WOW and the network to assist you in your efforts: "Changing Technology: Changing Jobs for Women," and "High Technology: A Primer," two documents from our latest publication "Bridging the Skills Gap: Women and Jobs in a High-Tech World." These two documents explain in greater detail WOW's position on the subject of high technology and women's employment.

The publication is the product of a 1-year research and action project WOW launched this year, called "Bridging the Skills Gap," to help fill the information void suffered by program operators, and to increase the involvement of the women's employment and training community in the increasing number of forums being convened to identify solutions to the technology skills gap issue.

Six months into the project, even before we have moved into more detailed research by industry, we have learned several things, which I will briefly summarize.

First, few policymakers and industry leaders speak the same language when they bandy the term "high-technology." Our initial investigation has shown us that, in fact, there are three distinct categories pertaining to high-tech industry, each having different skills needs and different employment potential.

The first of these categories is pure high-tech industries—in all about 36 of the 977 industries in our economy. These industries employ such professionals as systems analysis, industrial engineers, and electronic technicians who design and manufacture electronic components, scientific instruments, etc.

The second category is high-tech intensive industries—which include an additional 56 industries, such as chemical producers, petroleum refiners, and manufacturers of textile, electronic and medical equipment.

The third category, however, is user industries, which are simply those businesses or organizations that use the products of high-tech industries, such as retail stores, services, et cetera, but have little or no involvement in their development or manufacture.

This sector represents the major source of employment for most women. These distinctions and their employment impact are more fully explained in our primer.

A second finding is that State and regional forums convened to discuss the high-tech employment issue have not focused on the employment and training implications of these three distinct industrial sectors. Instead, they have devoted considerable attention and resources to a limited number of options, mainly the attraction of high-tech corporations into States in the hopes of recreating such high-tech meccas as California's Silicon Valley, Route 128 in Massachusetts, and North Carolina's Research Triangle.

Topics debated at these forums include tax credits for corporate relocation, zoning and land-use reform, and a number of other issues. However, scant time has been allocated to the employment and training requirements of these three industry categories.

Although there are few exceptions, one significant departure from this practice which we have observed has been in the State of Maryland. There, a statewide effort has been initiated not only to attract a mix of high-tech industries to the State, but to revamp the employment and vocational training systems to train residents for jobs in these new companies.

We believe the failure to assess what, if any, share of the three high-tech industry sectors is suitable, or even obtainable, for a State and what training is needed to support the industry is a waste and diversion of scarce dollars.

A third finding of our research is that while many employers wish to be involved in training workers for new or redesigned jobs, few employers can realistically underwrite the cost of this training and retraining, nor have they the expertise to do so.

In addition, most of the employer concerns and solutions to the skills gap issue to date have focused on short-term skills needs. What these employers fail to recognize is that we are fast moving toward what one expert terms a training/skills obsolescence/retraining cycle, which may be repeated three—and as often as five—times in a worker's life.

The fourth finding is that public and private leaders and the media have persistently focused our attention on the plight of a small, though important, segment of the work force, the dislocated worker. This narrow focus has the effect of obscuring the development and implementation of strategies for training the structurally unemployed, who are persons that face employment barriers even when the economy is healthy.

Even under the progressive plan of the State of Maryland, we have witnessed several forums devoted entirely to retraining the dislocated worker—without comparable time devoted to the employment and training needs of the structurally unemployed.

Despite the vast amount of attention given to displaced workers, however, they are, without exception, portrayed as male, auto, steel or other manufacturing industry or construction workers.

We would like to be on record as stating emphatically that in addition, telephone operators, bank tellers, stenographers, and other workers in predominantly female occupations suffer dislocation. Also included are workers in Federal occupational, where RIF's of women employees far exceed their representation among the civil service population.

The two populations, dislocated workers and structurally employed persons, are distinct. They have different employment and training needs and each requires different strategies. Little can be gained by pitting these two groups against each other in the rush for public and private dollars.

A fifth finding is that there is a conspicuous absence of women's employment and training programs from state and regional high-tech forums. The decade of experience of these pioneers in designing and testing recruiting, counseling and training techniques and models, particularly in technical and nontraditional occupations, is especially needed in light of the fact that women will account for two out of every three entrants in the work world of the future.

The sixth finding is that in our conversations with program operators, like ourselves, we hear a concern that is seldom voiced in policy and planning forums on the high-tech issue. It is that advanced technology may hold the potential for new, well-paid employment opportunities for women, but that technology absolutely represents a triple threat. First, women face possible job dislocation and job displacement as improved machine intelligence reduces the number of workers needed to perform such jobs as telephone operators, secretaries, bank tellers, and bookkeepers. Second, women face the threat of long-term unemployment, due to lack of access to the training needed to successfully compete for newly created technical jobs. Finally, women face possible tracking and segregation into new technical job ghettos, such as keypunch operators or data entry clerks.

Because of the national shift from a manufacturing-based economy to one based on services and technologically produced information, and because over 80 percent of today's working women are employed in the service sector, advanced technology holds more of a threat for women workers than a promise.

Pat Choate, in his report for the Northeast-Midwest Institute, called "Retooling the American Work Force Toward a National Training Strategy," July 1982, points out that although women are the major source of new workers in the 1980's, no institution has integrated women fully into its professional managerial, technical, and production jobs.

> Completing this process must be a major item on the nation's economic and social agenda over the remainder of the 1980's. Specific programs are required to recruit, train and place adult women in occupations that are nontraditional for their sex. Techniques for such programs have been created and can be replicated.

On this note, I would like to use the remainder of my time to share with you one such model, the WOW model. Since 1975, Wider Opportunities for Women has worked with both local and national industry representatives to develop and operate nontraditional skills training programs.

The programs serve economically disadvantaged, primarily minority women, most of whom function at a third to seventh grade reading and math level. Many of the women come to the WOW functionally illiterate.

The WOW model is designed to meet not only the exacting standards of employers but the very specific employment needs of women who are entering new and, for them, nontraditional areas of employment. The curriculum combines job and industry related basic science, math, and communications education with hands-on skills training, job and career counseling, employment advocacy, job development, supportive services, such as counseling, referral, and assistance with child care, housing, transportation, and other job-related problems, placement, and followup.

Our placement in preceding years has ranged from 80 to 85 percent, and even in these recessionary times, where the unemployment rate in the District is higher than the national average, we have maintained a 60-percent placement rate with average starting wages of $5 to $9 per hour.

Graduates are placed in jobs as service technicians for computers, typewriters, calculators, electronic cash registers, farecard machines, et cetera. They are also placed in jobs as printed circuit inspectors, electronics testers, electrician apprentices, communication signal workers, ratio maintenance workers, systems maintenance mechanics, general communication installers/repairers, wastewater treatment plant mechanics, gas turbine powerplant mechanics, and hydroelectric machinery mechanics, among others.

Successful placements have been made with Metro bus and subway system, Comsat Corp., Amtrak, Washington Gas Light Co., Potomac Electric Power, IBM, the Washington Suburban Sanitation Commission, and other employers. Our program provides trainees with the background and transferrable skills they need to tackle increasingly complex and technical jobs.

Not only have we found the WOW model to be successful for the Washington, D.C. market, but the model is also replicable for other jurisdictions as well.

Under an 18-month CETA title III grant, we have worked with Montgomery County to train their staff to use the successful WOW training techniques to operate a high skills program for economically disadvantaged clients in Montgomery County. Operating under grants from Pitney Bowes and IBM, we provided technical assistance for 10 months to enable women working in Hackensack, N.J., to replicate WOW's successful industry linked electromechanical training model.

In closing, I would simply like to restate a few obvious points. In order for the United States to remain competitive in the world market, it must invest in training and retraining its human capital.

We must also look realistically at just who is in the labor market, and who requires what training, particularly the large sector of the structurally unemployed. We must target programs to meet the needs of the various populations.

Neither Government, nor business, nor community-based employment organizations or educational institutions can solve the employment and training problems alone, but together workable solutions can be found.

Finally, we must clearly face an important fact: the cost of this training and retraining effort will not be cheap.

[The prepared statement of Dr. Madison and supplementary material follow:]

TESTIMONY OF

AVRIL J. MADISON
EXECUTIVE DIRECTOR

WIDER OPPORTUNITIES FOR WOMEN, INC.

Good Morning Mr. Chairman, Members of the Sub Committee. I am here today representing both WOW and the 130 independent women's employment and training programs which are affiliates of WOW's Women's Work Force Network Project.

I commend both Chairman Walgren and Chairman Gephardt, the rest of the Committee and their staff for the approach they have taken in planning such comprehensive and timely hearings to discuss high technology and employment. I offer the resources of WOW and the Network to assist you in your efforts. In the interest of brevity, I am submitting for inclusion in the hearing record Changing Technology: Changing Jobs for Women? and High Technology: A Primer, two documents from our latest publication, Bridging the Skills Gap: Women and Jobs in a High Tech World which explain in greater detail WOW's position on the subject of technology and women's employment. Thank you.

For quite some time Wider Opportunities for Women has been aware of the chainging skills needs of private industry. In our own skills training program, we work with a private industry advisory group to identify employment opportunities and to design training to meet employers skill needs. This continued working relationship has, over the years, resulted in a strong industry/government/labor - partnered program which provides training to bring women from a no or low skill level to entry level skills. I will go into greater detail on this program later in my testimony. While we have been in the position of working with industry to obtain the information needed to train women for the labor market, we are beginning to experience some of the frustrations that many of the women's employment organizations around the country have been experiencing for some time. A brief description of the experience of one veteran program operator affiliated with our network is illustrative.

The program, located in the Southeast has for over 10 years trained women for nontraditional occupations. With the areas high unemployment, the program is having a hard time placing trained women in nontraditional or even traditional jobs. Now the program operator is seeing a new group of women come for help — typists, stenos, tellers — who are seeking direction in anticipation of lay offs. Unable to gather the industry and occupational information it needs to provide training and career counseling, the program is at a loss for direction.

This frustration is felt not only by the women's employment and training community but by industry. One executive interviewed in a recent Business Week summed up the impasse as follows: "We have 1940's institutions trying to solve 1980's problems."

In response to this frustration and seeming impasse, WOW launched this year a research and action project, called Bridging the Skills Gap, to help fill the information void suffered by program operators and to increase the involvement of the women's employment and training community in the increasing number of forums being convened to identify solutions to the technological skills gap issue.

Six months into the project, even before we move into more detailed research by industry, we have learned several things:

> First, few policy and industry leaders are speaking the same language when they bandy the term "high technology." Our initial investigation has shown us that in fact there are three distinct categories pertaining to the high tech industry -- each having different skills needs and different employment potential. Briefly, they are:
>
> - "pure" high tech industries - in all about 36 of the 977 industries in our economy. These industries employ such professionals as systems analysts, industrial engineers, electronic technicians, to design and manufacture electronic components, scientific instruments, etc.
> - high tech intensive industries - include an additional 56 industries such as chemical producers, petroleum refiners and manufacturers of textile, electronic and medical equipment.

Sales and service workers and laborers constitute a very small segment of this labor force. Altogether employment projections for the 92 industries classified as high tech or high tech intensive are expected to be only 4% of the nonagricultural work force over the next 10 years.

> - user industries - are simply those businesses or organizations that use the products of high tech industries, such as retail stores, services, etc., but have little or no involvement in their development or manufacture. This sector represents the major employment source.

These distinctions and their employment impact are more fully explained in our Primer.

Second, we have learned through the project that: State and Regional Forums convened to discuss the high tech/employment issue have not focussed on the employment and training implications of these 3 distinct industry categories but instead have devoted considerable attention and resources to a limited number of options -- mainly the attraction of "high tech" corporations into states in the hopes of recreating such high tech meccas as California's Silicon Valley, Route 128 in Massachusetts, and North Carolina's Research Triangle.

At these forums, tax credits for corporate relocation, zoning and land use reform, and a number of other items have been debated but scant time has been allocated to the employment and training needs of these 3 industry categories. One significant departure from this practice which we have observed has been in the state of Maryland. There, a statewide effort has been initiated not only to attract high tech industries to the state but to revamp the employment and vocational training systems to train residents for jobs in these new companies.

We believe the failure to assess what -- if any -- share of the high tech industry is suitable or even possible for a state and what training is needed to support the industry is a potential waste and diversion of scarce public dollars.

Third, we have learned that while many employers wish to be involved in training workers for new or redesigned jobs, few employers can realistically underwrite the cost of this training and retraining or have the expertise to do so. In addition, most of the employer concern and solutions to the "Skills Gap" issue have focused on short term skills needs and fail to recognize that we are fast moving towards what one expert terms a training - skills obsolescence - retraining cycle which may be repeated as much as 3 times in some workers' lives.

Fourth, Public private leaders and the media have persistently focused our attention on the plight of a small - though important - segment of the workforce--the dislocated worker--with the effect of obscuring the development and implementation of strategies for training the structurally unemployed.

Even under the progressive plan of the state of Maryland, we have witnessed several forums devoted entirely to retraining the dislocated worker without comparable time devoted to the employment and training needs of the structurally unemployed.

Even with this focus on dislocated workers this population is without exception portrayed as male auto, steel or other manufacturing industry or construction workers. We'd like to be on record as stating emphatically that in addition, telephone operators, bank tellers, stenographers and other predominantly female occupations suffer dislocation, as well as federal workers where RIFs of women employees far exceed their representation among the civil service population.

The two populations are distinct with different employment and training needs and each requires different strategies. Little can be gained by pitting these two groups against each other in the rush for public or private training dollars.

- Fifth, there is a conspicuous absence of women's employment and training programs from state and regional high tech forums. The decade of experience of these pioneers in designing and testing recruitment, counseling and training techniques and models (particularly in technical and nontraditional occupations) is particularyly needed in light of the fact that women will account for 2 out of every 3 entrants in the work world of the future.

  Sixth, our conversations with program operators like ourselves reveals a truth that is seldom voiced in policy and planning forums on the high tech issue. For women, advanced technology may hold the potential for new, well paid employment opportunities but it absolutely represents a triple threat:

  - dislocation and job displacement as improved machine intelligence reduces the number of workers needed to perform tasks - as telephone operator, secretary, bank teller and bookkeeper.

- o long-term unemployment due to lack of access to the training needed to successfully compete for newly created technical jobs;
- o tracking and segregation into new technical job ghettos - such as keypunch operators or data entry clerks.

Because of the national shift from a manufacturing-based economy to one based on services and technologically-produced information; and because over 80% of today's working women are employed in the service sector, the threat of advanced technology is presently more real than its promise.

Pat Choate, in a report for the Northeast-Midwest Institute called Retooling the American Work Force: Toward a National Training Strategy (July, 1982), points out that women are the major source of new workers in the 1980s--but that no institution "has integrated women fully into its professional, managerial, technical and production jobs. Completing this process must be a major item on the nation's economic and social agenda over the remainder of the 1980s ... Specific programs are required to recruit, train, and place adult women in occupations that are nontraditional for their sex. Techniques for such programs have been created and can be replicated."

On this note, I'd like to use the remainder of my time to share with you one such model, the WOW model.

Since 1975, WOW has worked with both local and national industry representatives such as IBM, Xerox, COMSAT, AT&T Long Lines, Metro, Washington Gas Light Company and Pepco to develop and operate nontraditional skills training programs. The programs serve economically disadvantaged--primarily minority--women. Most function at the 3rd to 7th grade reading and math level. The WOW model is designed to meet not only the exacting standards of employers, but the very specific employment needs of women who are entering new and--for them--nontraditional areas of employment. The curriculum combines job and industry related basic science, math, and communications education with hands-on skills training, job and career counseling, employment advocacy, job development, supportive services (such as counseling, referral and assistance with child care, housing, transportation, and other job-related problems), placement, and follow-up.

Our placement rate in preceeding years has ranged from 80-85% but even in these recessionary times we have maintained a 60-65% placement rate with average starting wages of $5.00 to $9.00 per hour. Graduates are placed in such jobs as: service technician (for computers, typewriters, calculators, electronic cash registers, fare card machines, etc.); printed circuit board inspector; electronics tester; electrician apprentice; communications/signal worker; ratio/maintenance worker; systems maintenance mechanic; general communications installer/repairer; waste treatment plant mechanic; gas-turbine power plant mechanic; hydro-electric machinery mechanic; and many more.

Successful placements have been made with Metro (subway and bus system), COMSAT Corporation, Amtrak, Washington Gas Light Company, Potomac Electric Power Company, IBM, the Washington Suburban Sanitary Commission, and other employers.

Our program provides trainees with the background and, transferable skills they need to tackle increasingly complex and technical jobs. Not only have we found the WOW model to be successful for the Washington, DC job market, but the model is also replicable for other jurisdictions as well.

For example:

> Under an 18 month CETA Title III contract with Montgomery County (Md.), WOW provided technical assistance to the Montgomery County Skills Training Improvement Program (STIP) staff. WOW adapted the successful techniques and methods used in its nontraditional work training programs to train the STIP staff to operate a high skills program for economically disadvantaged clients enrolled in Montgomery County Electronics Technician Program.
>
> Operating under grants from Pitney Bowes and IBM, WOW's technical assistance, provided from September 1980 to July 1981, enabled Women Working in Hackensack, New Jersey to replicate WOW's successful industry-linked model electro-mechanical training program. WOW assisted the staffs of both Women Working and the Prime Sponsor in program design and development. WOW also facilitated the program's link with local branches of IBM, Pitney Bowes and other national corporations with which WOW has working relationships. Women Working has now been funded to operate the model under a contract with the Private Industry Council of Bergen County, New Jersey.

In conclusion, I'd just like to restate a few obvious points. In order for the United States to remain competitive in the world market it must invest in training and retraining our human capital. We must also realistically look at just who is in the labor market and who makes up a large sector of the structurally unemployed and target programs to meet the needs of the various populations. We must realize that neither government nor business nor community-based employment organizations can solve the employment and training problems alone; but that together workable solutions can be found. And finally, we must realize and accept the fact that the cost of this need for training and retraining effort is not cheap.

Submitted by Avril Madison

Wider Opportunities for Women

Bridging the Skills Gap: Women and Jobs in a High Tech World

Wider Opportunities for Women, Inc.
Washington, D.C.
April 1983

I. Changing Technologies: Changing Jobs for Women?

An Issue Brief

INTRODUCTION

Throughout the 1980's and 1990's, women workers will be called upon to confront and cope with an increasingly important economic and employment policy issue--the "skills gap". The term "skills gap" was coined to characterize the widening "gap" between the number of skilled workers in demand by industry and the number of workers actually possessing the required skills needed by industry. The rapid pace and sweeping nature of technological advance, lagging education, employment and training systems, and the mega-shift of the U.S. economy away from a manufacturing-base all serve to underscore the immediacy of the skills gap problem.

State and local policy makers, alarmed at declining state economies, spiraling unemployment and worker dislocation, have initiated meetings with industry leaders and labor market experts to devise ways in which to move their states into the high tech future. To date, most strategies have focused on the duplication of California's Silicon Valley, North Carolina's Research Triangle and Route 128 in Massachusetts. Tax and land use reforms to provide relocation incentives for high tech companies are coming before state legislatures with increasing frequency. State and industry-hosted forums to develop ideas to revamp state education and employment training systems to prepare workers for the technical job market are gaining momentum. But few forum participants have recognized the tremendous employment resource women workers represent nor have they begun to examine the implications for women workers of both the advanced technology revolution and the ever widening skills gap.

A WOMEN'S EMPLOYMENT ISSUE

The conspicuous absence from these forums of women's employment program operators and women's employment advocates contributes to and perpetuates the invisibility of women's employment concerns. For over a decade, community-based women's employment programs have been an important but unrecognized partner in the employment and training system. By operating recruitment, counseling and/or training programs to prepare women for well paid, high demand jobs, they have also served as an important employer resource for skilled workers. They are often the only community resource available for a woman seeking career information and training which is free of sex-bias and sex-stereotyping. Their pioneering work in such areas as career counseling, job placement assistance, information and referral and skills training--particularly for nontraditional occupations--has helped countless women overcome barriers to employment in well-paid, high-demand jobs. Many of their innovations in programming, curriculum-development, and training have been recognized and adopted by educational and vocational institutions throughout the country.

These advocates are familiar with both the consequences of sex-stereotyping and the systems which perpetuate it. Because of this experience they, more than others, are most likely to perceive and understand both the positive and negative employment implications for women of a technological work world: i.e., the opportunity for new and better jobs and conversely the prospect of dislocation, unemployment and new, low-wage technical job ghettos.

Increasing numbers of these community-based women's employment programs are looking for ways to help individual women cope with the "skills gap"--but they, like government and industry leaders, are at a crossroads. Industry and government have both reached the frustrating realization that the methods we use to forecast new jobs and the systems we rely upon to educate and train workers for these jobs are woefully inadequate to the task confronting them. One CEO interviewed by Business Week summarized the impasse: "We have pre-1940 institutions trying to deal with post-1980 concerns."[1] Similarly a local program operator describes the dilemma of many employment and training practitioners:

> Unemployment here is high. It is hard for women to get hired in the blue-collar nontraditional jobs when there are so many lay-offs. Even the women we see who are looking for traditionally female jobs are having a hard time. And now we are seeing a new group of women come in--typists, stenos, clerks--who are anticipating lay-offs because of automated systems. This group is asking for direction. We tell them what we have read about the high tech job market, but that's where it ends. We can't point to any training and tell them to go there. And we don't have enough specifics to begin training women for these jobs. Where do we go from here?

In order to design and implement effective and successful policies and systems at both the state and national levels to bridge the skills gap, all partners should be represented in the process. At present experienced women's employment program operators and advocates are not a part of the discussions which include government, union, and industry leaders, and representatives from educational and training systems. Because men and women are similarly unprepared for the new work world, there is the opportunity to design systems which will not mirror the sex segregation common in our current education, employment and training systems and in the paid labor market. On the other hand, women's employment programs need the information exchanged at these government/industry forums in order to identify the new jobs and to design and test the generic training needed by women workers and industry to prepare adequately for the opportunities that already exist or are anticipated.

Rising unemployment, the threat of job lay-offs and dislocation, and the inflationary erosion of family incomes makes advanced technology and the skills gap of concern to all workers. However, three overwhelming factors make this a priority issue for women workers:

- Women are the fastest growing segment of the job market today and, this trend is expected to continue to increase through the end of the century.
- Most of the skills gap issues of the 1980's and 1990's will center on occupations in the service sector where over 80% of today's working women are employed.
- Deficient backgrounds in math and science caused by sex-stereotyped educational counseling have left the majority of women workers and job seekers ill-equipped to enter jobs or training for the new technical occupations.

WOMEN IN THE WORKFORCE

Women's increased rate of entry into and length of participation in the paid labor market has been one of the most significant economic facts of the decade. Between 1971 and 1981 over 15 million women entered the workforce; and, almost one million additional women will enter the workforce each year throughout the 1980's--comprising 2 out of every 3 new entrants.[2] Despite this increased workforce participation by women, their earning capacity is undercut by unemployment, low wage jobs, years out of the labor market for childbearing and rearing and part-time employment. All of these factors combine to keep women and the families they support at the bottom of the economic ladder.

A 1983 report by the U.S. Commission on Civil Rights,[3] found that 61% of Black, 51% of Hispanic and 45% of White women in the labor force in 1980 were either unemployed or underemployed compared to 35% of White men. At the same time, the number of women who are the sole support of themselves and their families and therefore must enter the paid labor market, has doubled in the last 20 years. During the period the number has risen from 4.5 million in 1960 to 9.4 million in 1981. In addition, the proportion of these families which are poor is increasing drastically. In 1981, 70 percent of poor black families, 50 percent of poor Spanish-origin families, and 39 percent of poor white families were maintained by women. Seven million children live in these households.[4] Despite their increasing sole responsibility for child rearing, women's wages for full-time work still average only 60 percent of men's wages--an actual decline since the 1950s. Indeed, the proportion of women and female-headed households living in poverty has burgeoned so astronomically in the past decade that a new term has been coined to describe it: "the feminization of poverty."[5]

The inability of many women to find full-time employment further erodes their ability to adequately support themselves and their families. But even among part-time workers, women heading families are most likely to be poor. The poverty rates for those who could only find part-time work in 1980 exceeded 56% for women maintaining families and 26% for men (in nuclear families). Almost 56% of women maintaining families who were employed at any time during 1980 were poor--the rate for men experiencing unemployment in 1980 was 14%. The poverty rates for women who looked for but could not find work at all during 1980 were extremely high, reaching 85% for women maintaining families alone--the corresponding rate for men was 53%.

Despite the fact that women and men work in the paid labor market for the same reasons, women typically receive less economic benefit for their labor than men. Societal stereotypes, women's dual responsibility for work and the family and outright discrimination based on sex (and compounded by age and race discrimination) result in the sex segregated job market which poorly rewards the work women do.

Although there are more than 44 million women in the paid labor market today, 80% are restricted to just 20 of the 420 listed occupational categories--mostly in retail sales, service, clerical, factory or plant work. The growth of job opportunities in these traditionally-female occupations has not kept pace with the growing number of female job seekers. As a result, women make up the majority (66%) of "discouraged" workers--those who have actually given up looking for paid employment. Of those women who found jobs in 1978, only 9.9% held well-paid traditionally "male" jobs; while 21.6% held sex-neutral jobs; 68.5% were segregated into low-paid traditionally "female" jobs.[6] In a 1979 study on the median weekly wages of full-time workers, the Bureau of Labor Statistics reported that sales work (which has a traditionally female work force) generated $154 per week for female workers and $297 per week for male workers.[7] This disparity is frequently the case. The chart below illustrates the economic consequences of job segregation by sex. Note that the effect is compounded when race is added as a factor:

Occupations of Fully Employed Workers, 1980

	All men	Both sexes	White women	Black women	Hispanic women	Ratio of median earnings of women and men
Total	100%	100%	100%	100%	100%	59.4%
Professional, technical, and kindred	17.6	18.2	19.5	17.6	10.9	65.6
Managers and administrators, except farm	18.2	15.3	11.0	4.3	7.1	55.3
Sales workers	6.1	5.5	4.7	2.6	4.0	48.9
Clerical and kindred workers'	6.2	17.9	40.2	34.8	36.2	59.1
Craftworkers, foremen, and kindred	21.5	14.6	2.2	1.4	3.2	61.5
Operatives, except transport	10.1	10.1	9.7	11.3	22.0	60.4
Transport equipment operatives	5.2	3.5	0.4	0.3	0.1	61.5
Laborers, except farm and mine	4.5	3.3	1.0	1.4	1.4	59.0
Private household workers	(')	0.3	0.6	2.0	2.3	75.1
Service workers	6.9	8.7	10.1	24.4	13.0	(')
Farmers and farm managers	2.5	1.7	0.3	(')	(')	61.2
Farm laborers and foremen	1.1	0.9	0.4	(')	0.1	(')

Reprinted From: U.S. Commission on Civil Rights, A Growing Crisis: Disadvantaged Women and Their Children, Washington, D.C., May 1983.

Job segregation is a result of many factors, but bears no relation to years of schooling. Women and girls attain as many or more years of schooling as men and boys. In 1980, more than 26% of Black, 23% of Hispanic and 20% of White women were overeducated for their jobs.[8] According to 1979 Census Bureau statistics, women with one to three years of college earn $2,000 less than men who have completed eighth grade. This outright discrimination by race and sex in the job market is reflective of the sex stereotyping and discrimination in education and training programs which contribute to and perpetuate women's limited occupational options.

Of the more than 17 million students enrolled in federally-funded vocational education courses or programs (roughly half of them women), 7 million are in occupationally specific vocational programs. Despite limited success in overcoming sex stereotyping women are still channelled into traditionally-female programs. In 1971, 65% of all female students were in traditional programs for nursing and secretarial and food service work; this percentage decreased to 52% in 1980. But the total for all traditionally-female programs in 1980 was 78.8%. Race and ethnicity did not significantly change the sex-defined programming patterns. A closer examination of the types of occupational training in which women are involved more clearly reveals the long-term labor market implications. In secondary school programs, nearly 70% of the girls are in programs leading to below-average-wage occupations and less than 10% are enrolled in programs leading to the highest paid jobs. In post-secondary school programs the corresponding figures are 60 and 12 percent respectively[9] these jobs not only perpetuate sex segregation in the job market, but many are destined to become obsolete within the decade. Phyllis McClure in "Race and Sex Compliance Issues in Vocational Education" concludes that: "Jobs for which women and minorities are trained in vocational schools are still the lowest paid, the most menial, the least skilled, and the most restrictive of upward employment mobility."

Compounding this problem is the inability of our labor information and management systems to adequately forecast what the new jobs will be, and of our employment, training and education systems to develop training and education programs to provide workers with the skills they will need to fill these jobs. For example, the latest edition of the Dictionary of Occupational Titles contains no listing for "robot technician" a fast growing occupation. In addition, the Bureau of Labor Statistics has only recently developed a definition for the term "high technology". A recent edition of Business Week describes the consequences of our lagging systems: "Like the industrial revolution, the information revolution is rendering existing educational, political, social and economic institutions largely obsolete.... [A]nd there seems to be little government or corporate planning to ease the transition . . . So far, only a few individuals have given thought to the shape new [institutions] should take."[10]

GROWTH OF THE SERVICE SECTOR

The employment future for most women continues to lie in the so-called service sector of the labor market, but women's options must be broadened to allow for their full participation at all occupational levels within this sector. It is this sector which is expected to undergo the most dramatic change and bear the brunt of the skills gap problem throughout the 1980's and 1990's.

Over two-thirds of the nation's workers currently are employed in industries that provide services such as health care, insurance, trade, education, government, repair and maintenance, transportation and banking. Industries that produce goods through farming, construction, mining and manufacturing employ less than one-third of the country's work force. BLS statistics show that employment in the service-producing industries has increased about 30%--from 60.4 million workers in 1978 to 78.4 million by 1990.[11] Although this growth trend is expected to continue past 1990, technological innovation will radically change both the kinds of jobs and the employment outlook for the individual industries within the service sector--just as it has in the traditional manufacturing industry.

Already the auto, chemical and steel industries have adopted robots to perform many of the jobs traditionally held by men. Peter Drucker, in The Next American

Work Force, predicts that between 10 and 15 million jobs will be eliminated in the manufacturing sector by the end of this decade due to technological advance. Drucker in addition states that an equal number of service jobs will become obsolete during this same period. Since over 80% of today's working women are employed in service occupations, the impact of advanced technology is of acute importance to individual women and women's employment advocates. The explosion of computer and telecommunication technology and applications in the last ten years has virtually redesigned whole occupational categories in the service sector From being almost nonexistent a decade ago, output from high tech industries are expected to make up over 10% of the GNP by 1993.

The rapid proliferation of computers, medical and telecommunications equipment, automatic tellers and cash registers and their equally rapid integration into our daily lives has already transformed the work world for all workers--particularly for women workers. These changes have resulted in job loss for some, new job opportunities for a few, and new job ghettos for others. The potential for job change due to technology cuts across all job categories. Jobs in several service occupational categories are expected to expand through 1990, including the categories of manager, clerical and sales worker. But new technology will radically change the nature of these jobs and result in dislocation, unemployment, and/or retraining of current workers. For example:

> Managers and Administrators - includes bank officers and managers, buyers, credit managers and self-employed business operators. This group will grow between 1978 and 1990 from 10.1 to 12.2 million or 21%.[12] The demand for salaried managers will grow in highly technical areas of operation. Middle management, where women are just beginning

> to be represented, is shrinking in many larger corporations; and, computer literacy is a growing requirement. Companies like GE, Xerox, Kodak, and Honeywell are using the computer's instant access for information and technical analysis to replace many of the middle management functions.
>
> Clericals - includes bank tellers, bookkeepers, cashiers, secretaries and typists. Between 1978 and 1990 employment is expected to grow by 28%, from 16.9 to 21.7 million.[13] New developments in computers, office machines and dictating equipment will greatly affect employment in many occupations within this group. Many types of office machine operators will decline as well as the need for stenographers and other types of billing and file clerks. At the same time, the need for computer and peripheral equipment operators will increase, as will the need for clerical workers whose jobs involve a high degree of personal contact.

For most women workers (both those seeking entry and those already in the work force) advanced technology poses not only new job opportunities but a triple threat: (1) dislocation and job displacement as improved machine intelligence reduces the number of workers needed to perform tasks; (2) long-term unemployment due to lack of access to the training needed to successfully enter or compete for newly-created technical jobs; and (3) tracking and segregation into new technical job ghettos.

THE COMPUTER INDUSTRY

A detailed look at the integration of computer technology into the work place and its impact on women's jobs provides a vivid illustration of the complex issues confronting women workers. Because of its almost unlimited application to other fields and because of the agreement among educators and employment specialists that basic "computer literacy" is the key for being able to survive in the technical world, the computer industry is particularly illuminating.

Between 1970 and 1981 the number of women programmers and computer systems analysts more than tripled and the proportion of such workers who were women rose 27%.[14] During the same period, the number who were computer operators grew tenfold and their proportion more than doubled to reach 64%.[15] In contrast, the introduction of computer technology into telecommunications has led to a 30% decline in the number of women employed as telephone operators over the same eleven-year period.[16] Similar declines are being recorded in other "female" occupations such as stenographer, bank teller, insurance clerk.

Despite these employment gains and losses in the computer field, a look behind the statistics at the actual jobs held by women reveals an all too typical story. Seventy-eight percent of the women now working in the computer industry are keypunchers or computer operators, the lowest paid of the computer related occupations, whereas only 31% of the men hold these lower-level jobs. Even then, 1980 Department of Labor statistics reveal that across computer-related job categories, men are consistently paid more money than women in the same position. In their 1980 annual salary survey, Datamation, a nationwide computer trade publication, attempted to include a detailed documentation of the salary differentials between men and women, but failed because few companies were willing to report comparative figures. Still, some of the anecdotal evidence they collected was quite telling. One manager who responded to the survey said, "We don't pay enough to hire males, so 83% of our programmers are female."[17]

Because of the rapid growth of the computer industry, new positions and job titles are constantly created. However, two trends operate to keep women in computer industry ghettos: the lack of mobility both between different job classifications and between broad industry areas. This is true first, because business, scientific and engineering areas each require different training and remain separate and distinct entities despite the job title, so transfer between industries is extremely limited.[18] Most of the women in the computer industry are concentrated in the relatively lower-paying business industries.[19] Second, the lowest paying job classifications (data entry clerks, computer operators) have very short career ladders; and a women in these jobs can expect to move only one or two rungs to the level of immediate supervisor.[20]

CONCLUSION

Shorter product life cycles, which reflect improvements in the underlying technology, will accelerate the pace with which changes in the workplace will occur. But as we can see from this review of the computer user industry, women workers will not automatically benefit from these changes.

Pat Choate, in a report for the Northeast-Midwest Institute called Retooling the American Work Force: Toward a National Training Strategy (July, 1982), points out that the growth of the American workforce is slowing dramatically as the "baby boom" generation matures. He notes that women are the major source of new workers in the 1980s--two of every three new workers--but that no institution "has integrated women fully into its professional, managerial, technical and production jobs. Completing this process must be a major item on the nation's economic and social agenda over the remainder of the 1980s . . . Specific programs are required to recruit, train, and place adult women in occupations that are nontraditional for their sex. Techniques for such programs have been created and can be replicated."

FOOTNOTES:

1. A New Era for Management, "The Disenchantment of the Middle Class", Business Week Special Report, April 25, 1983, p.82.

2. Pat Choate, Retooling the American Work Force: Toward a National Training Strategy, Northeast-Midwest Institute, July 1982, p.6.

3. U.S. Commission on Civil Rights, A Growing Crisis: Disadvantaged Women and Their Children, Washington, D.C., May 1983.

4. Ibid.

5. Wider Opportunities for Women, "The Feminization of Poverty", Issue Brief, Washington, D.C., 1981.

6. Ibid.

7. Ibid.

8. U.S. Commission on Civil Rights, op cit., p.23.

9. Ibid.

10. Business Week, op cit., p. 84.

11. Bureau of Labor Statistics, "Future Jobs", Washington, D.C., January 1983.

12. Ibid.

13. Ibid.

14. Jan Zimmerman, "Computer Careers for Women: Dead End Jobs in Growing Field?", final manuscript, January 1982.

15. Louise C. Shaw, "1980 Salary Survey", Datamation, April 1981, pp. 110-114.

16. Bureau of Labor Statistics, op cit.

17. Jan Zimmerman, op cit., p. 4.

18. Ibid.

19. Ibid.

20. Ibid.

II. High Technology: A Primer

HIGH TECHNOLOGY - WHAT DOES IT MEAN?

Although a definition of the term "high technology" cannot be found in today's dictionaries, it has become part of our everyday vocabulary. Its meaning can literally be derived from the two words "high" and "technology" to mean the current level of sophistication of a developing technology or "state of the art".

The term "high tech" is most commonly used as an adjective to describe scientific theories, applications, equipment and products, industries and occupations. Given this broad usage of the term, exact definitions vary from one source to another and "high tech" is often used as a catchall to describe any high growth industry, new products in the marketplace, et al which may or may not represent advanced or "state of the art" technology.

WHAT ARE THE CHARACTERISTICS OF HIGH TECH INDUSTRIES?

The core of today's high tech industrial sector is the computer manufacturing industry. Companies in this industry produce the physical components of the computer such as the mechanical, electronic and magnetic units known as "hardware" and the programming languages and translators, operating systems and applications programs of the computer known as "software".

Computer technology is the most rapidly expanding high tech field because of its almost unlimited applications to areas such as communications, information handling, business problem-solving, medical diagnosis, chemical analysis and geological prospecting. Advanced computer technology has facilitated and stimulated development and innovations in other high technologies such as robotics (robots), fiber optics (lasers), satellite communications, and many other fields.

An economic definition to a "high tech industry" is one in which the research and development expenditures and number of technical employees are twice as high as the average for all U.S. industries. In all only about 36 of the 977 industries in our economy meet this criteria. Examples of these industries are designers and manufacturers of computer equipment, electronic components, communication equipment, engineering and scientific instruments and equipment, and aircraft/aerospace equipment as well as computer service industries and research laboratories.

In addition fifty-six industries qualify as "high tech intensive" which means they are characterized by R & D spending and technical personnel above the national average. Examples of industries in this category include most chemical producers and petroleum refiners as well as manufacturers of textile, printing, electrical and medical equipment.

WHO ARE HIGH TECH USERS?

High tech users can simply be defined as those businesses or organizations that use the product of the high tech industries but have little or no involvement in their development or manufacture. Today we are witnessing the widespread use of computers for business applications. Robots are being introduced in manufacturing (especially auto manufacture). Airline companies operate highly complex communications systems using supercomputers. Virtually every sector of the economy has the potential for usage of high technology products as the nation shifts from an industrial economy to an information/services economy.

HOW WILL HIGH TECH INFLUENCE EMPLOYMENT?

The most significant trend in jobs and careers over the next 20 years will be the transition from jobs involving basic manual skills such as manufacturing work, office typing and filing duties to jobs involving the supervision of technical machine processing, programming and systems analysis. This shift will continue as robots are used more in manufacturing and computers are used more in offices.

Employment in High Tech Industries. Professional and technical occupations predominate in high tech industries and include electronic and industrial engineers, electrical and electronic technicians, computer specialists such as programmers and systems analysts, economists and accountants. Operatives--including assemblers, machine operators, checkers and examiners, and clerical workers--including secretaries, computer and peripheral equipment operators, and stock clerks also constitute a significant proportion of workers in these industries.

Other occupational groups represented in high tech industries are craft and kindred workers--data processing machine repairers, heavy equipment mechanics and installers, and managers and administrators. Sales and service workers and laborers constitute a very small segment of those employed in the high tech sector.

Altogether total employment for the 92 industries classified as high tech and high tech intensive was about 3 million in 1979 or about 3 percent of the nonagricultural labor force. Employment has been projected to increase by 850,000 jobs over the next ten years but will continue to represent a low proportion of total employment--about 4 percent.

Major reasons for the relatively low employment in the high tech sector include: low output as compared with other manufacturing sectors (e.g. the auto industry's output is more than twice the output of all 92 industries); rapidly rising productivity within high tech industries (i.e., output per employee is expected to increase at a greater rate than the number of workers needed to produce increased high tech output over the next ten years); and increasing use of automation within these industries.

Significantly the majority of the new jobs generated by high tech industries over the next ten years will be in nontechnical occupations. It has been estimated that about one-third of all new jobs offered by high tech employers will be for operatives. Clerical and management occupations will account for approximately one-fifth of job openings followed by engineers (16%), craft workers (14%), and engineering and science technicians (10%).

Employment in High Tech Occupations. Given the increasing prevalence of computers in the workplace, occupations associated with the computer field such as programmers, operators and service technicians will increase but in terms of overall employment these occupations will continue to represent a small proportion of available jobs. According to government projections for 1990 covering occupations in all industries, professional and technical employees will account for about 15% of the labor force. Within this category, technical engineers will represent 1.2%, engineering and science technicians, 1.1% and computer specailists, 0.5%. These estimates imply that high tech occupations will continue to grow but play a limited role in terms of overall employment.

Employment in an Information/Services Economy. By 1990 it is estimated that clerical workers, service workers and sales workers will represent 19.1%, 14.6%, and 6.7% respectively of the workforce. Although these occupations are not classified as high tech jobs, the data should not be interpreted to mean that persons in these fields will not be exposed to or involved in the use of high tech products and equipment. As we are increasingly aware, the exact opposite is true given the increasing usage of automated systems in the workplace. Government agencies predict that by the end of the decade 50-75% of all jobs will be computer-related. These will include occupations such as secretaries, typists, bookkeepers, cashiers, bank tellers, stock clerks, health and protective service workers, and retail, wholesale and manufacturing sales employees.

WHERE ARE WOMEN IN THE HIGH TECH ENVIRONMENT?

Women in High Tech Occupations. Very few women are employed in high tech industries since many positions require advanced degrees in engineering and related scientific and technical fields that few women possess. During 1980 only 4% of all engineers and physicists were women.

Women are represented to a greater degree in computer departments of various industries and businesses but continue to confront the same occupational segregation women have experienced in other work environments. Occupations in computer-related fields include (beginning with the lowest salary level): keypunch operators and data entry clerks, computer operators, computer technicians, computer programmers, systems analysts, other computer specialists including marketing and sales representatives, and project leaders. Seventy-eight percent of women in computer-related occupations work as keypunch or computer operators--positions which offer the lowest wages in the field. Only 31% of men in the field hold these lower-level positions.

In 1980 women constituted only 29% of all computer programmers and 22% of all systems analysts and a very small number were involved in mid or high-level management. Government labor statistics indicate that the pattern of wage inequities experienced by women across all occupational lines holds in the computer field where women receive distinctly lower wages than their male counterparts in each of the major computer job categories. (Note that this is true also for the few women employed as engineers and scientists. A recent study by the National Research Council found that women in these technical fields receive salaries 32% lower than their male counterparts.)

Women as Workers in an Information/Services Economy. The overwhelming majority of women in today's workforce are engaged in clerical and service occupations. The characteristics of these jobs are changing as the use of computerized equipment becomes an integral part of job performance. Many women do not possess the requisite skills to use high tech products and therefore must bridge the "skills gap" to maintain employment. This gap continues to widen as new and more sophisticated high tech equipment becomes commonplace in offices and businesses.

Employers have generally responded to these changes in two ways. In some instances employees who were not trained for the new equipment were terminated and replaced by workers who brought the skills to the job. In other cases employers have trained or retrained their personnel to use the new equipment. Unfortunately too often this training represents a "bandaid" approach to the skills gap problem since the training offered is application- or machine-specific and renders skills that are not easily transferred to other similar jobs or equipment. For women increased office automation may actually reinforce their occupational segregation by yielding overspecialized office occupations.

WHAT ARE THE KEY HIGH TECH ISSUES FOR WOMEN?

The high tech dialogue is just beginning. Working women, women's employment program operators, women's employment advocates, government, union and industry leaders have the opportunity to work for policies that will improve employment options for women as well as men in high tech occupations. Encouraging computer literacy, increasing access to technical education and training programs, and promoting sex equity in the workplace are a few of the many ways in which policies can support sex equity for women.

Computer literacy--There is an evergrowing need in our society to become "computer literate" as we encounter, with increased frequency, computers and related equipment at work, school, shops, and home. Understanding computers and their applications as well as gaining the ability to use the equipment are fast becoming requirements for employment in occupations at all wages levels.

Educators, trainers and employers can contribute to bridging the skills gap by designing, supporting and implementing programs which provide women with an understanding of the basic concepts associated with high tech products and their applications.

Access--In order to improve women's entry into highly advanced technical fields such as engineering, educators and prospective employers need to further articulate skills requirements and contribute to the design of curricula at elementary, secondary and postsecondary levels that will encourage and facilitate the entry of women into high tech professions.

In order to prepare women for occupations where the use or knowledge of high tech equipment is required, government employment and training agencies, private industry and community-based organizations need to advocate and develop instructional programs for women that will provide sufficient counseling, training, and hands-on experience to meet employment criteria.

Occupational Segregation--Women's employment advocates in the high tech arena must promote sex equity in terms of wages and career advancement as they formulate employment and training policies for women entering or already in this environment. Government and union leaders must assert a strong and united effort to promote and enforce equal employment opportunity and affirmative action laws already on the books.

Employers must encourage and provide access to opportunities for women in computer fields to gain advanced technical training and promote the movement of professional women into higher skilled, better paying computer fields such as systems design, computer engineering, and data network communications as well as marketing and management positions.

Similarly employers need to offer training and retraining programs to office workers that go beyond teaching women how to use one specific high tech product or perform only specialized organizational tasks on the equipment. Employers should offer training that teaches basic underlying technical concepts of the high tech equipment so that the employee can transfer her skills to other work settings and applications while developing a better understanding of her current position.

Mr. **Dymally**. Thank you, Dr. Madison.

From time to time, this committee confers degrees on witnesses for their testimony, and we have just awarded you the doctorate degree. And the diploma is in front of you in a very crude sign there.

Thank you very much. We will come back to some questions.

Mr. Finnell?

[The biographical sketch of Mr. Finnell follows:]

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Co-Chairmen

John R. Opel
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Robert A. Finnell

ROBERT A. FINNELL

Mr. Robert A. Finnell is President of the National Action Council for Minorities in Engineering, Inc. (NACME). NACME, a private sector initiative to increase the number of graduates in engineering and related fields, operates an Incentive Grants Program that supports over 3,000 students in engineering schools, a college Retention Project, a Technical Assistance Project for pre-college, university, and corporate programs, a Student Identification Program and a Planning and Research Program. Mr. Finnell joined NACME on June 1, 1983.

Prior to joining NACME, Mr. Finnell was Executive Director of Mathematics, Engineering, Science Achievement (MESA) at the University of California, Berkeley. He managed MESA from 1977 to 1983 during the period when MESA expanded to four states and 150 high schools serving 4,000 students and 14 campuses where 1,000 undergraduates receive support services. MESA's initial foundation and corporate support is now matched by state funds.

From 1974 to 1977 Mr. Finnell was Deputy Director of the Committee on Minorities in Engineering at the National Research Council, National Academy of Science in Washington, D.C. His previous positions include the Assistant Directorship of the first national bilingual education study, and the directorship of the Community Development Corporation of Austin, Texas. He taught the eighth grade in Edna, Texas and was on the faculty of the Department of English at the University of Texas at Austin and the University of Pennsylvania.

Mr. Finnell is currently Chairman, Committee on Public Understanding of Science, American Association for the Advancement of Science and a member of the Committee on Equal Opportunity in Science and Technology, National Science Foundation.

For his work in the minorities in engineering effort, Mr. Finnell was awarded the Reginald H. Jones Distinguished Service Award in 1981.

Mr. **Finnell.** Thank you, Congressman Dymally.

I am Bob Finnell. I was invited as executive director of MESA, mathematics, engineering and science achievement, at the University of California in Berkeley, to comment on the issues of training and retraining that you are discussing here today.

Since that invitation, I have accepted the presidency of the National Action Council on Minorities in Engineering. Both are private sector, precollege, and university level programs aimed at increasing the number of students from underrepresented minority groups who complete BS degrees in engineering and related technical and science fields.

Therefore, I would like to concentrate my testimony on what we can do to increase the number of secondary school students who graduate from high school with the college preparatory mathematics, science and English courses necessary to pursue a math-based field and then followup on the university level.

The technological impact on employment and education that we are discussing today occurred because of breakthroughs made by scientists, engineers, mathematicians and others. That is what is driving change in our society.

Other speakers have focused on retraining issues, vocational ed issues, and so on. I would like to focus on building the kind of intellectual and technical talent that we need if we are going to replace and, indeed, increase the supply of math-based graduates so that we can compete both domestically and internationally.

First of all, there is no question that the new technology is straining the traditional approaches to education. We don't have the teachers in place or coming on stream who can provide the types of training in the secondary schools, or for that matter, at other educational levels.

We don't have the curriculum in place; we don't have the tools in place. The bills in various States, whether they range from the $40 million bills to the $800 million bills, to improve education are just a sign as to what it is going to take to retool our educational system. It is going to cost well into the hundreds of billions of dollars.

And even those attempts will not succeed unless we are able to attract to teaching and professorships the brightest students who can work in an atmosphere that is conducive to instruction of students, and where they have the respect that enables them to continue in those fields, rather than as they have previously, moving into industry or Government.

Second, I think that the types of training programs that I am discussing are needed throughout the country, but particularly in urban areas. For the last 9 years, I have been working with underrepresented minority students, and as you are well aware, if you examine student enrollments in the largest 10 cities in the countries, or the largest 20 for that matter, the school districts are very heavily, if not a majority of, black, Mexican-American, and Puerto Rican students.

And many times, when we refer to the problems in training and retraining, we are merely looking at the consequences of not having looked at our educational system in any way different than we looked at our infrastructure, be it roads, bridges or anything else. We neglected it.

But I would suggest that unless we concentrate on the urban areas where most of our population is living, we can predict the same consequences that urban areas in other countries have experienced when the populations were excluded from the mainstream of employment and jobs.

What I would like to focus on, however, are the characteristics of the training programs that will build the supply of students that we need. You have asked me in my testimony to draw on my background in MESA.

MESA began about a decade ago in the Berkeley area, and its principle was very simple; if you wanted more minority students to participate in math-based programs at the university level, they had to have 3 or 4 years of math, science, and English.

Now, this sounds old hat today, because everyone who reads the paper is aware that there are commissions and boards that have studied this. But 10 years ago, as Congressman Dymally is well aware of in California, there were no requirements for mathematics if you wanted to attend the California State system, and if you wanted to attend the University of California system, you only needed 2 years of math.

So, what we were doing in advocating 3 or 4 years of math, science, and English for the students who basically were not attending the university system, fell mainly on deaf ears. We could have had our meetings on the subject in broom closets.

Our objective was to show that from the racially isolated school districts and from other schools where blacks and Mexican Americans were concentrated, we could produce competent, qualified students who excelled in math, science, and English.

I am pleased to report that 10 years into this exercise, we have universities now that are graduating 30 and 40 engineers that previously graduated 2, and in the 130 high schools that we work in in California, we are graduating 3 and 4 times as many students with the 4 years of math, science, and English as previously were there.

We did this by building a partnership with industry for the first 6½ years of the program. It was funded by corporations, and foundations, and the volunteer efforts of university faculty, and other professionals who worked in industry or had their own businesses.

Mr. DYMALLY. Let me interrupt you for a moment. We have a call for quorum.

Mr. FINNELL. Yes, sir.

Mr. DYMALLY. And then, it would be followed by possibly a vote in 5 minutes. So you are talking about 15 to 20 minutes. How much more time do you have in your testimony?

Mr. FINNELL. I will wrap it up in 5 minutes.

Mr. DYMALLY. OK. Three.

Mr. FINNELL. OK.

I would like to recommend, then, that this committee recognize that we need a national policy for tripling or quadrupling the number of students completing the first year of mathematics by the 9th or the 10th grade, and that we have a sixfold increase in the number of students completing the third or fourth year of math by the time they get out of high school.

This will mean, then, that the students who graduate and possibly go into retraining have the language, the mathematics, and the scientific skills to go through retraining.

Second, I would recommend that successful program models be used rather than reinventing the wheel when new Federal, or State, or private dollars are made available.

Third, I would like to recommend that the future science education or programs that we are talking about here today involve cooperation of industry, universities, and other local institutions who have already indicated a commitment to this area.

Finally, I would like to recommend that an increased share of the Nation's financial resources, both from the private sector and the Government sector, be invested in this type of program.

Thank you, sir.

Mr. DYMALLY. Thank you, too, Mr. Keffer, Ms. Madison and Mr. Finnell. It is quite possible we may be delayed on the floor, and since you have completed your testimony, we would like to have the privilege of submitting the questions to you in writing. The staff will do that. I have some myself.

And so we will write you. We want to thank you very much for your testimony. I am afraid we may be delayed on the floor, and since you have completed your testimony, it would seem to me not to make sense to keep you any longer. So thank you very much, and we will communicate with you.

[Material to be supplied follows:]

Questions

Submitted by the Hon. Mervyn M. Dymally

1. What do you see as the best way to provide mobility between low-skill or low-wage jobs and high-skill or high-wage jobs?

2. One suggestion for displaced workers has been not to put them into separate institutions for training, but to encourage employers to hire and train displaced workers by offering prorated subsidies for their salaries, easing off as the workers' skills become adjusted to the work requirements. From your experience, what would you think of this kind of program?

3. Can you make some specific suggestions about the best way to divide federal, state, and local government roles in the training and retraining area?

4. In the past days of hearings we have heard that work in technical areas will not be solving our unemployment problems. Instead, most jobs will be in low-skill areas. Could you philosophize on the implications for training and retraining?

5. It is a perpetual problem that training institutions cannot keep up with the needs of industry. As a person intimately involved with training and retraining, could you give us some idea of how willing employers are to open up their plants and equipment for use by training and retraining institutions? Does this willingness vary by industry? If so, what is the nature of the variation?

6. Congressman MacKay has drawn an interesting distinction between education and training. Training is a process people go through in order to do a specific kind of work. Education is a more liberal-arts-based learning which prepares people not so much for work as for life. Does education have a role in training now? Should it have a role in the future? What should the role be? Why should (or should not) education have a role in training?

7. One experiment that is being tried in the area of youth unemployment is to pay youth to attend school during the summer rather than paying them for a temporary job. Could you speculate about the wisdom of this approach, especially for long-term adult employment?

8. You have mentioned, in essence, that we don't foretell the future well as far as jobs are concerned. How can we get better at foretelling the future? Is it possible?

9. I have heard it said that most employers prefer to train their own personnel. Their problem is that they have difficulty obtaining people who are easily trainable. That is, people lack basic education on which the employer can build. Could you

comment on the relative value of turning training programs outside of industry toward basic education versus having these programs train people in specific trades. Should there be a mix of basic education and training or should all resources be put in one or the other?

10. In some school districts, there are certain schools where so-called "problem children" are put. These schools resemble jails and really are holding places rather than educational institutions. Could you say something about how the educational system should change so that the students that would normally go to these holding institutions might get a more positive and useful experience in the educational institution?

11. It is out of the question that current equipment can be provided in every training institution. But it is not out of the question that each institution in a state could specialize such that one place is the robotics center, another the electronics center, etc. But there is resistance within the institutions. Each institution wants a little of everything even if it is outdated. How can we restructure training institutions to make better use of very expensive equipment?

SINGER

EDUCATION DIVISION

August 17, 1983

The Honorable Richard A. Gephardt
The Honorable Doug Walgren
U. S. House of Representatives
Committee on Science and Technology
Suite 2321
Rayburn House Office Building
Washington, D.C. 20515

Dear Messrs. Gephardt and Walgren:

Thank you for your July 22 letter and for the follow-up questions which accompanied that letter.

Responses to your questions are as follows:

1. My proposal for addressing these issues is for the government to a) conduct effective surveys of opportunities and publicize the results, b) offer effective assessment and counseling programs for those who are in need and c) offer effective skill training programs because people with appropriate skills will have a better opportunity.

2. From our experience, subsidized worker programs tend not to work as well as specialized training programs. We try to upgrade our current employees whenever possible.

3. This response is largely a matter of opinion, of course, but local efforts visualized under JTPA seem to us to have a better chance of success than past efforts. At least this is worth a try. On the other hand, hard core unemployment problems seem to me to require a major federal effort because of their size and origin and because the solutions frequently require mobility beyond local jurisdictions.

4. As suggested in my testimony, I think the business community itself should be encouraged to handle higher level skill training and retraining. The education community must provide the raw material in the form of people resources. Government skill training should concentrate on the many skills where there will be jobs over the next two decades, but in areas which are not regarded as "high-tech".

THE SINGER COMPANY 8 STAMFORD FORUM, STAMFORD, CONNECTICUT 06904 203 356-4200

5. I do not know employers who are prepared at this time to offer their own facilities to training and retraining institutions.

6. I agree with Congressman MacKay's definitions of education and training. I also agree with those who propose that formal education should start earlier and that secondary education should be completed earlier. With that background, I think that education should have a very small role in training. Instead, it should prepare the young person well through liberal-arts-based learning.

7. In my opinion such an approach will do nothing for the benefit of long-term adult employment, and it could lead to a very expensive program. The monies could be spent more effectively on a longer school year, perhaps in combination with completion of secondary school at an earlier age.

8. I am sorry if I left the impression that future job potentials could not be predicted. I think that surveys by the government and others are effective and need to be updated frequently. These updates are important. The Time magazine prediction which I cited in my testimony is very credible. My suggestion, however, is that many people in and out of government are tending to ignore the surveys of skill requirements.

9. Please refer to No. 6 above which suggests emphasis on education rather than training in our secondary schools.

10. I do not feel qualified to answer this difficult question. Our Job Corps Centers often receive these "problem" children at a later age. Through a combination of circumstances, success is often achieved; a) the youngster begins to realize the failure which can result from bad habits and attitudes, b) the youngster begins to recognize the need for a skill, and c) the Job Corps program teaches the value of self-discipline and provides entry level skills.

11. I think that government expenditure for sophisticated equipment should continue to be modest. This will force institutions to specialize over the long run, at least.

Hopefully, I have answered these questions to your satisfaction. If there are any further questions, please feel free to ask.

Sincerely yours,

Charles F. Keffer

Charles F. Keffer
President, Education Division

CFK/ep

WOW
Wider Opportunities for Women, Inc.
A nonprofit tax-exempt Women's Employment Organization
1325 G Street N.W., Lower Level, Washington, D.C. 20005 (202) 638-3143

August 30, 1983

Dear John,

Here are our answers to the hearing questions. Sorry for the delay.

Sincerely,

April

[illegible]ril J. Madison
[illegible]utive Director

1. Mobility Between Low Skill/Wage Jobs and High Skill/Wage Jobs

A key to upward mobility in the labor market would be the commitment of employers to objectively evaluate the performance of employees at all skill and occupational levels and promote career development programs that capitalize on human potential. Many employers tend to segment career ladders within an organization along occupational lines. This approach can undervalue and often ignore abilities derived from previous work experience and/or educational backgrounds of workers and not take into account job-derived skills such as work experience outside the scope of an occupational classification, knowledge of an organization's business practices and related experience.

Women, in particular, have been subjected to this form of occupational segregation as they continue to be tracked into low-wage/skill job ghettos despite superior work performance and/or qualifications that would make them candidates for higher skilled occupations and consequently improved earnings. For those workers who are not prepared to advance without additional education and training, employers should offer career development programs to productive employees on equitable bases.

It is also important to note that skill levels do not always dictate wage levels. Statistics compiled by the Department of Labor reveal that on the average women continue to earn less than 60% of their male counterparts when compared on like occupational bases. Similarly, society does not always reward those persons in occupations where significant education and training may be required -- such as the teaching profession -- with commensurate salary levels.

In sum, WOW supports legislative efforts aimed at promoting economic equity for all workers and employment practices that encourage mobility across occupational lines and provide career development programs (education and training) to fully realize employee potential.

2. Training Subsidies for Displaced Workers

Much warranted attention has been given to the plight of the "displaced" or "dislocated" worker, given the unacceptably high level of unemployment in the U.S. today. Unfortunately the term "displaced worker" has been used in an extremely narrow sense to refer to a displaced industrial worker (read male) and not always considered in a broader and more accurate sense to include any worker whose occupation or employer is in a state of permanent decline resulting from technological change and/or changing market conditions (e.g. foreign competition).

Furthermore, many proposed programs offer solutions to the unemployment problem that focus primarily on the individual worker subgroup and fail to consider the much larger population of those workers without jobs and hope of employment -- the structurally unemployed. This group includes individuals who have difficulty entering and staying in the labor market because they do not meet minimum skill requirements. The number of structurally unemployed workers will continue to grow as more sophisticated technical skills establish new baselines for entry level jobs. Consequently their needs will have to be addressed in order for the United States to increase its productivity and maintain a competitive position in world markets.

WOW has continually supported legislation aimed at easing the economic deprivation associated with job loss for all workers and continues to support policies that protect workers and promote employer accountability in situations where changing skills requirements or relocation become the rationale for terminating employees. We have learned from Washington area employers that many companies (particularly small businesses) are unable to underwrite the cost of training and retraining and/or lack the expertise to do so. As a result we would support measures that would encourage employers to maintain their present work force at full salary levels while retraining employees through either in-house or contracted skills-enhancing programs.

We also strongly urge the Congress to promote legislation aimed at educating and training the structurally unemployed to meet the increasingly difficult entry-level requirements posed by newly developing technology-based industries and businesses.

3 & 8. Federal, State and Local Responsibilities & Labor/Job Forecasting.

As you have heard from several witnesses, there is currently no uniform way in which we conduct labor market and occupational forecasting. Our ability to accurately forecast is hindered by an inadequate, and often nonexistent data base. Without this basic information, program operators are unable to design training needed to prepare workers for the current and future job market; states are unable to anticipate occupational declines and institute retraining or other relief; and national policymakers are unable to accurately shape labor and industry policy or plan resource allocations.

Despite this crying need for a comprehensive data base, we have heard from program operators in our national employment and training network that the typical top-down model of data collection and dissemination is virtually useless for their needs. What they see is the need for federal support for the development of local and state data collection systems which can be easily accessed (for example, through local library or employment service computer systems). The availability of data in this most refined form can be immediately used by program operators, employers and local policy makers for developing area employment and training plans and assessing the impact of these plans. Such a system would eliminate many of the costly "mistakes" currently being made by locales in training the unemployed for jobs which never existed, in training too many for too few jobs, and in training the unemployed for jobs which will become obsolete within a short period of time. From this basic building block, state and national collection and analyses of data can be conducted. In this way, a staged, but uniform implementation of a comprehensive data collection system would begin to be useful and effective immediately.

4. Training and Retraining for Future Jobs

Given the lack of consensus among experts in the field of occupational forecasting and the rapid technological reshaping of the economy, no one has been able to predict with any degree of certainty the number or ratio of skill levels associated with jobs of the future. Based on today's job market, however, we are able to identify an increasing need for technical professionals and workers possessing basic skills in math, science, and computers.

In my testimony I distinguished high tech and high tech intensive industries from downstream sectors of the economy that use products developed and manufactured by high tech businesses. Although a very small proportion of the labor force is predicted to be employed by high tech industries over the next decade, the use of their output has and will continue to create additional new job opportunities throughout the economy.

While the majority of new jobs may not require advanced degrees in engineering or physics, it is likely that many will require more educational background in technical subjects than is required of today's work force. Furthermore, many nontechnical occupations such as sales, office work, etc. will necessitate some form of skills development given the proliferation of high tech equipment,such as computers, in work environments. As a result training and retraining should become a standard part of many occupations as technological changes continue to occur and workers are forced to accommodate to equipment changes and other alterations in the workplace.

As an organization that seeks employment equity for women, WOW sees the transition in the economy and the new jobs brought about by technological change as an opportunity to bring more women into the mainstream of the labor force and into a greater variety of occupations (especially at a time when recognition of the need for training and retraining is taking hold for workers at all levels.) Because women have traditionally been underrepresented in technical occupations we will continue to support and work for training programs that prepare women for those future jobs that require technical competencies.

5. Industry/Training Organization Cooperation

The willingness of employers to participate in cooperative training efforts is directly related to the population in need of training. Despite a continued need for skilled workers, employers are consistent in telling us that it is not economically feasible for them to train the structurally unemployed for higher paying, technical work. In addition the truly structurally unemployed find themselves not represented in any large numbers in traditional training institutions. With the help of community-based employment and training organizations, the structurally unemployed can be brought to the point of "job readiness" where it then becomes economically feasible for employers to invest in further training. To insure a constant supply of job ready, productive workers, employers are willing to assist CBO's by loaning equipment, instructors, training space, etc. Under this reciprocal arrangement employers are able to get the workers they need and use scarce resources to add-on to the already productive worker's skills (rather than beginning from "zero"); community based organizations obtain otherwise unaffordable state-of-the-art equipment and assistance in making the training fit the real job market; and, the structurally unemployed are able to compete for jobs which are upwardly mobile and which lead to economic self-sufficiency for themselves and their families.

For example, in our own nontraditional training program for women companies such as IBM, Metro, Pitney Bowes, Comsat and C & P Telephone have forged a true partnership with WOW by:

- o advising on the training curricula to insure that the training provided meets industry standards;
- o providing instructors to help train women on new equipment and worksite behavior; and,
- o donating broken equipment for hands-on class repair exercises.

This model has since 1972 been particularly successful in training structurally unemployed women for the so-called "nontraditional" occupations. Building the trust level on the part of the training organization and the employer is a long-term process though. No federal, state or local policies are currently in place to act as a primary incentive or to provide mainstreamed support for this effective model. While the Job Training Partnership Act was designed to encourage increased participation by employers in the private sector in training and retraining, the role of the community-based organization has been diminished--and there is little evidence that regulations implementing the new Act will remedy this situation.

6. Education vs. Training

While it is true that Congressman MacKay's distinction between education and training has held true for a number of years, we now find that technological change is effectively blurring these lines of distinction. For example, employers of the women trained in our electronics, electromechanics, and construction trades program all ask, besides basic background technical training, that their new employees possess cognitive skills, and the ability to identify and solve problems, and understand what is appropriate behavior on the worksite. Unfortunately, the longevity of a trainee's academic career is seldom an indicator of the attainment of these important skills. In fact, our training program has departed from the practice of using a years-in-school criterion as an indicator of successful program completion (and employment), and has instituted testing to assess a trainee's functional level in math/computation and reading/comprehension. This change has been very revealing. For example, in a recent group of trainees 55% had completed 12 or more years of formal schooling, but the functional levels for math/computation and reading/comprehension averaged 5th grade and 7th grade, respectively. Compounding this problem was the fact that most of the women in this group (which is typical of our training population) had either never participated in the paid labor market or had only held sporadic marginal jobs.

As a result, the WOW training program provides not only hands-on technical skills training, but training in math, communications, logic/problem-solving, and work readiness. It is the training in these latter (traditionally education-centered) skills which actually determine the woman's ability to get and keep a job after she leaves the program.

Finally, in response to employers' needs and our own sense of the changing labor market, we have moved increasingly away from providing job specific training and more towards providing generic skills training in technical areas. Generic skills training enables the trainee to choose from a large range of job options, thereby increasing the chance of initial and continued employment. The refinement and training for a specific task or job occurs rather quickly on the worksite at relatively small expense to the employer. In the face of rapid technological change, the move to this type of generic training is the only logical route to insuring that employers have a constant supply of skilled workers and that workers can continue to find productive employment without the effect of long periods of "down time" for job-specific retraining.

9. Training the Work Force -- Whose Responsbility Is It?

Its difficult to conceive of a general formula that would provide an appropriate allocation of resources among employers and others for worker training given the diversity and differences in programs associated with specific occupations. In general it would make sense for both the external training sector (e.g. colleges, vocational education institutions, community-based training programs and others) and employers to continue to participate in the training/retraining of skilled workers. One major concern of WOW is not necessarily related to who provides the training but that programs exist that bring workers up to employers' standards for meeting hiring criteria and that access to these programs be made available on a sex-equitable basis.

As you are aware WOW has operated skills training programs for women in non-traditional occupations since 1972. These programs have been designed primarily for structurally unemployed women who have difficulty finding jobs because they lack sufficient education, training, or have worked in traditional female occupations that pay poorly and are shrinking in terms of new jobs being created.

Our programs are characterized by intensive classroom instruction in technical math, communications (oral and written), and laboratory instruction (hands-on experience) in electronics and mechanics combined with occupational and job counseling. Through these programs we promote the development of basic skills in our trainees that allow them to enter technical fields and prepare them for further on-the-job training.

WOW strongly supports this type of "generic" or pre-employment training for the structurally unemployed because the skills developed during the program can be carried on and used in a variety of employer, industrial and occupational settings and are not limited to any particular employment situation. This type of training has become increasingly important as employers introduce new technologies into the workplace that necessitate retraining of employees.

We also believe that Congress should take into account the issue of transferrable skills when allocating resources to training programs. It is important for Congress to fund strategies and approaches that encourage employers and external training organizations to offer instructional programs that go beyond the accomplishment of equipping workers with narrowly defined job-specific skill requirements. Models of these types of programs do exist. They have been used by a variety of organizations including the Urban League, SER, many community-based employment and training centers such as WOW and others and have proven to be extremely effective in working with the structurally unemployed.

Ms. MADISON. Thank you.

Mr. DYMALLY. Thank you.

[Whereupon, at 11:50 a.m., the subcommittee and the task force adjourned.]

TECHNOLOGY AND EMPLOYMENT

THURSDAY, JUNE 16, 1983

House of Representatives, Committee on Science and Technology, Subcommittee on Science, Research and Technology, and the Committee on the Budget, Task Force on Education and Employment,
Washington, D.C.

The subcommittee and task force met, pursuant to call, at 9:45 a.m., in room 2318, Rayburn House Office Building, Hon. Doug Walgren (chairman of the Subcommittee on Science, Research and Technology) presiding.

Present: Representatives Walgren, Gephardt, Brown, Dymally, MacKay, Williams, Boehlert, Sensenbrenner, and Skeen.

Mr. **Walgren.** Let me call us to some kind of order and we will get started. I apologize for being a little bit late this morning. So, we should start with dispatch.

This is the 6th day of these hearings held by the Science, Research and Technology Subcommittee of Science and Technology and the Task Force on Education and Employment of the Budget Committee.

We are trying to gather a broad record that will be of interest to members on those committees and other members in thinking about the limitations of technological change for employment, and whether or not we are on ground that will present the kinds of changes in the future that we have not experienced in the past, and how our government can best contribute to maximizing the benefits of those changes and minimizing the problems inherent in changes of the dimension that new technology is going to be presenting to our economy.

At the outset, let me say that we would like to try to keep the presentations within a 10-minute frame. That isn't an absolute rule. We certainly know that we would like to hear more. And please don't just stop because the second hand passes 10 minutes. But in fairness to getting through all the witnesses in a reasonable timeframe and to allow enough discussion, if you would be sensitive to that 10-minute frame, we would certainly appreciate it.

There is a red light down there that will go on in your peripheral vision just to be a reminder that 10 minutes has elapsed and if you could summarize at that point the remaining points you would like to make, it would work best, I think, in the overall.

Your written statements will be made part of the record without further ado and will be reproduced in whole.

We also would like to have any other submissions of interest that you think might contribute to the record.

The first panel this morning is focused on regional, State, and local perspectives. It includes Bruce Morgan, director of economics and social science of the Midwest Research Institute; Ray Stata, president, Analog Devices, Inc., and Lenny Siegel, director, Pacific Studies Center.

We appreciate very much your coming to the committee and giving your perspectives in this area.

Why don't we start in the order we called, with Dr. Morgan first.

[The biographical sketch of Dr. Morgan follows:]

BRUCE B. MORGAN
Director
Economics and Social Science Department

Dr. Morgan directs MRI's professional staff engaged in applied economic research and consulting. The department's areas of interest encompass strategic planning; economic analysis; business analysis; economic development; impact assessment; health, education, and social services.

Dr. Morgan specializes in economic and community development. Recent work has included development of MRI's target industry identification model, preparation of economic development programs for communities in Arkansas, Indiana, Colorado, Ohio, New Jersey, Missouri, and Alabama; and a capital improvement study of 30 governmental units in a metropolitan area. At the state level, Dr. Morgan has directed preparation of a framework for economic development in South Dakota; developed the standards, criteria, and program design for the All Missouri Certified City program, conducted a benefit cost analysis of the Iowa Community Betterment program, and designed Missouri's Urban Neighborhood Betterment program. He also has extensive experience in designing and implementing joint public-private sector approaches to economic development.

In other projects, Dr. Morgan has helped communities review their strengths and weaknesses and develop comprehensive community development programs. Such assistance has been provided to cities in Kansas, Iowa, and Missouri and to the 1985 Task Force in Kansas City. Dr. Morgan has conducted industrial sites evaluations in Belton and Grandview, Missouri, and Corning and Ottumwa, Iowa. He has also worked on futures programs such Iowa 2000, Goals for Missourians, and Kansas City's Alternative Futures program.

Dr. Morgan is a professional planner and a member of the American Institute of Certified Planners. Dr. Morgan received the M.S. in Community Development (1973) from the University of Missouri-Columbia, and the M.A. in Sociology (1977) and Ph.D. in Urban Studies (1979) from the University of Missouri-Kansas City.

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STATEMENTS OF DR. BRUCE B. MORGAN, DIRECTOR OF ECONOMICS AND SOCIAL SCIENCE, MIDWEST RESEARCH INSTITUTE; RAY STATA, PRESIDENT, ANALOG DEVICES, INC., AND LENNY SIEGEL, DIRECTOR, PACIFIC STUDIES CENTER

Dr. MORGAN. Thank you, Mr. Chairman, members of the committee.

The importance of high technology industry to regional economic development is reflected in the growth of these industries during the last 25 years. An estimated 75 percent of all U.S. manufacturing employment growth between 1955 and 1980 occurred within five broad categories of industries: chemical and allied products; machinery except electrical; electrical and electronic machinery; transport of equipment; and measuring, analyzing and controlling instruments.

I have been asked to address the impact of technology on the work force and environment, the differences, in jobs of the traditional industrial base versus new industries, and the Federal role in easing adjustment of workers to technology in the workplace. This charge is quite broad and really not possible to adequately address in such a limited time. However, in reviewing the agenda for your hearings, it is obvious you are considering several points of view. My task will be to review some of these issues in a local metropolitan area and the Midwestern States surrounding it.

Exhibit A contains a series of charts on the Kansas City metropolitan area and the Midwestern States surrounding it. The following are some of the major summary points reflected in these charts and other studies conducted by Midwest Research Institute.

The population of the Kansas City metropolitan area stabilized after several decades of growth.

The population continues to age with the median age in 1980 over 30 years and the age cohorts 25 to 40 comprising the largest population segment.

The suburbanization of jobs has occurred over the last decade, resulting in a shift of jobs from the central city to the suburban areas. The central core is basically comprised of manufacturing, government, finance, health care, and legal services, while the suburban areas include transportation and distribution, services, retail, and insurance.

The U.S. economy over the last 30 years has shifted from goods-producing to service-producing industries. This shift is also reflected in the Kansas City metropolitan area. The charts in exhibit A showing the percent distribution of nonagricultural employment by industry throughout the Midwestern States demonstrate a pattern, with some exceptions, of a substantial portion of total nonagricultural employment shifting to the service-producing sectors.

The Midwest has been in a severe economic recession for 3 years and is only beginning to show some signs of recovery. The impact of the recession in the Midwest has been more severe than some other regions of the country, as illustrated by the percent change in nonagricultural employment from 1980 through 1982.

In 1982, the last year of the recession, it was apparent that not all sectors of the economy were affected equally. Though not entirely unique, the goods-producing sectors or basic industries suffered greater set-backs in the the Midwest than the service-producing sectors. In looking at the basic employment and income-generating sectors in the region's economy, it was apparent that those industry sectors generating the greatest number of jobs and income were the ones hit the hardest by the recession and have suffered long-term and permanent damage.

The outlook for the Midwest in general is for a recovery slower than the rest of the Nation, and there are danger signs of long-term economic stress.

Midwest Research Institute has recently been interviewing chief executive officers of a selected sample of business and industries in the Midwest to find out their current assessment of the economy and the outlook. Slightly more than half of chief executive officers interviewed are cautiously optimistic on their overall assessment of the economy and believe there are some positive, but weak, signs of recovery. The greatest concerns among these CEO's is the continued weakness of the agricultural sector, the continued threats of ever-increasing Federal deficits, and those factors in the world economy which might weaken any long-sustained recovery.

Business and industrial leaders that we have interviewed are fairly consistent in their belief that additional investment is needed in plant and equipment, in both the public and private sectors. Additional investments in research and development are needed to strengthen educational institutions and basic research capability. We need to improve productivity and increase profitability, and we need more stable long-term financing to help rebuild capacity and make the necessary adjustments brought about by the overall economic climate.

Some industrial leaders that we have interviewed are feeling the impacts of new technology. These impacts are primarily felt in those industrial sectors that are undergoing major technological shifts.

For example, the unemployment in the automobile industry in Kansas City continues quite high even with some signs of a turnaround in the economy. Some of the unemployment that has occurred in the automobile industry is structural unemployment brought about by the introduction of industrial robots. This not only directly impacts the welder who no longer has a job because a robot has replaced him but also affects spin-off industries.

For example, a manufacturer of industrial safety equipment will be forced to make significant cutbacks because robots do not need protection—for example, hard hats, goggles, and masks—as does the human. So for each job displaced by a new technology in a basic industry, the multiples become quite high in other sectors of the economy.

MRI's definition of high technology industries refers to all business endeavors in which the access to and control over high technology resources is a critical and essential element for market success. That is, the technology component must be at least of equal importance, to or more important than, labor, capital, raw materials, or land. The enterprise, thus, must be recognized as technology-intensive—for example, unique technology, high proportion of scientists and engineers, and high R&D—as contrasted with the more usual descriptors of labor, or capital-intensive.

There seems to be no agreement at the Federal, regional, State or local level on what is high technology industry. Any definition of high technology suitable for purposes of economic development must be sufficiently broad to include a diverse mix of those industries which are technology-intensive and have experienced exceptional growth within recent years because growth industries have the resources to expand. Exhibit B contains a list of high growth and very high growth industries identified by MRI in the high technology area.

Communities and states which are looking to high technology industry as the single economic development strategy to replace the employment lost during this present recession are simply pursuing a dream. We have found that even though high technology industries are rapid growth industries, there are only a modest number of jobs in any community in high technology. Our findings have been consistent with those of the Bureau of Labor Statistics and others on this point.

Most States and major localities in the Midwest are pursuing high technology as an economic development strategy. The type of local initiatives that are being proposed at the State and local level include tax breaks, research parks, venture capital, incubator buildings, improvements to colleges and universities, and improvements in vocational and technical training facilities.

Our concern is that location factors for high technology firms—exhibit A, page 1023 are different for large firms versus small firms. In the exhibits, you will note that the large firms—for example, greater than 100 employees—focus primarily on labor pool, labor cost, education/training, and lifestyles as the top four location factors. Small firms, however, focus on proximity to markets, local government cooperation, overall cost of doing business, and labor costs.

We find that the majority of jobs are created by small firms and through the expansion of existing business and industry. An inordinate amount of state and local resources are being spent on an industrial strategy that will not produce enough jobs to replace the losses that are occurring to basic industries.

Our concern is that the overall economic structure of the Midwest is showing signs of maturing, resulting in a top-heavy tertiary economy based on service-producing industries. Unless innovation and investment are strengthened, we will see a continuing weakening of our economy.

We believe that the Federal interventions must recognize the need to stimulate the additional investment and innovation within both the public and private sectors at the State and local level. Federal interventions must stimulate the rebuilding of the deteriorated public facilities and services, provide additional research and development resources, especially in basic research areas, and result in a workable retraining program to help retool the human capital that is being displaced in some of the mature industries by technological changes. For example, a trade-adjustment assistance program could be a model.

In addition, investment tax credits, continuation of industrial development revenue bonds, and a broader program of guaranteed loans would aid the private sector and provide incentives for small business growth and development.

It will require a targeted and balanced economic development strategy at all levels if we are to succeed.

Thank you, Mr. Chairman.

[The prepared statement, plus additional materials submitted by Dr. Morgan, follow:]

TESTIMONY OF DR. BRUCE B. MORGAN,
MIDWEST RESEARCH INSTITUTE, KANSAS CITY, MISSOURI,
TO JOINT HEARING ON TECHNOLOGY AND EMPLOYMENT OF
THE SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY OF THE
COMMITTEE ON SCIENCE AND TECHNOLOGY, AND THE TASK FORCE
ON EDUCATION AND EMPLOYMENT OF THE HOUSE BUDGET
COMMITTEE, WASHINGTON, D.C., JUNE 16, 1983

IMPACT OF TECHNOLOGY ON THE WORK FORCE: A REGIONAL, STATE, AND LOCAL VIEW

The importance of high technology industry to regional economic development is reflected in the growth of these industries during the last 25 years. An estimated 73 percent of all U.S. manufacturing employment growth between 1955 and 1980 occurred within five broad categories of industries: chemical and allied products; machinery except electrical; electrical and electronic machinery; transportation equipment; and measuring, analyzing, and controlling instruments. I have been asked to address the impact of technology on the work force and environment, the differences in jobs of the traditional industrial base vs. new industries, and the federal role in easing adjustment of workers to technology in the work place. This charge is quite broad and really not possible to adequately address in such a limited time. However, in reviewing the agenda for your hearings it is obvious you are considering several points of view. My task will be to review some of these issues in a local metropolitan area and the midwestern states surrounding it.

THE ECONOMIC CLIMATE

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- * The population of the Kansas City metropolitan area stablized after several decades of growth.

- * The population continues to age with the median age in 1980 over 30 years and the age cohorts 25 to 40 comprising the largest population segment.

- * The suburbanization of jobs has occurred over the last decade resulting in a shift of jobs from the central city to the suburban areas. The central core is basically comprised of manufacturing, government, finance, health care, and legal services while the suburban areas include transportation and distribution, services, retail, and insurance.

- * The U.S. economy over the last 30 years has shifted from goods producing to service producing industries. This shift is also reflected in the Kansas City metropolitan area. The charts in Exhibit A showing the percent distribution of nonagricultural employment by industry throughout the midwestern states demonstrate a pattern, with some exceptions of a substantial portion of total nonagricultural employment shifting to the service producing sectors.

- * The Midwest has been in a severe economic recession for 3 years and is only beginning to show some signs of recovery. The impact of the recession in the Midwest has been more severe than some other regions of the country as illustrated by the percent change in nonagricultural employment from 1980 through 1982.

- * In 1982, the last year of the recession, it was apparent that not all sectors of the economy were affected equally. Though not entirely unique, the goods producing sectors or basic industries suffered greater set backs in the Midwest than the service producing sectors. In looking at the basic employment and income generating sectors in the Kansas City metropolitan region's economy, it was apparent that those industry sectors in the region's economy generating the greatest number of jobs and income were the ones hit the hardest by the recession and have suffered long-term and permanent damage.

* The outlook for the Midwest is for a recovery slower than the rest of the nation and there are dangers signs of long-term economic stress.

VIEWS OF MIDWEST INDUSTRIAL LEADERS

Midwest Research Institute has recently been interviewing chief executive officers of a selected sample of business and industries in the Midwest to find out their current assessment of the economy and the outlook. Slightly more than half of chief executive officers interviewed are cautiously optimistic on their overall assessment of the economy and believe there are some positive but weak signs of recovery. The greatest concerns among these CEOs is the continued weakness of the agricultural sector, the continued threats of ever increasing federal deficits, and those factors in the world economy which might weaken any long sustained recovery.

Business and industrial leaders that we have interviewed are fairly consistent in their belief that additional investment is needed in plant and equipment, in both the public and private sectors. Additional investments in research and development are needed to strengthen educational institutions and basic research capability. We need to improve productivity and increase profitability, and we need more stable long-term financing to help rebuild capacity and make the necessary adjustments brought about by the overall economic climate.

Some industrial leaders that we have interviewed are feeling the impacts of new technology. These impacts are primarily felt in those industrial sectors that are undergoing major technological shifts. For example, the unemployment in the automobile industry in Kansas City continues quite high even with some signs of a turnaround in the economy. Some of the unemployment that has occurred in the automobile industry is structural unemployment brought about by the introduction of industrial robots. This not only directly impacts the welder who no longer has a job because a robot has replaced him but also affects spin-off industries. For example, a manufacturer of industrial safety equipment will be forced to make significant cutbacks because robots do not need protection (e.g., hard hats, goggles, and masks) as does the human. So for each job displaced by a new technology in a basic industry, the multiplers become quite high in other sectors of the economy.

HIGH TECHNOLOGY AS AN ECONOMIC DEVELOPMENT STRATEGY

MRI's definition of high technology industries refers to all business endeavors in which the access to and control over high technology resources is a critical and essential element for market success. That is, the technology component must be at least of equal importance to or more important than labor, capital, raw materials, or land. The enterprise thus must be recognized as technology intensive (e.g., unique technology, high proportion of scientists and engineers, and high R&D) as contrasted with the more usual descriptors of labor, or capital intensive.

There seems to be no agreement at the federal, regional, state, or local level on what is high technology industry. Any definition of high technology suitable for purposes of economic development must be sufficiently broad to include a diverse mix of those industries which are technology intensive and have experienced exceptional growth within recent years because growth industries have the resources to expand. Exhibit B contains a list of high growth and very high growth industries identified by MRI in the high technology area.

Communities and states which are looking to high technology industry as the single economic development strategy to replace the employment lost during this present recession are simply pursuing a dream. We have found that even though high technology industries are rapid growth industries, there are only a modest number of jobs in any community in high technology. Our findings have been consistent with those of the Bureau of Labor Statistics and others on this point.

Most states and major localities in the Midwest are pursuing high technology as a economic development strategy. The type of local initiatives that are being proposed at the state and local level include: tax breaks, research parks, venture capital, incubator buildings, improvements to colleges and universities, and improvements in vocational and technical training facilities.

Our concern is that location factors for high technology firms (see Exhibit A) are different for large firms vs. small firms. In the exhibits, you will note that the large firms (e.g., greater than 100 employees) focus primarily on labor pool, labor cost, education/training, and life styles as the top four location factors. Small firms, however, focus on proximity to markets, local government cooperation, overall cost of doing business, and labor costs. We find that the majority of jobs created are by small firms and through the expansion of existing business and industry. An inordinate amount of state and local resources are being spent on an industrial strategy that will not produce enough jobs to replace the losses that are occurring to basic industries.

Our concern is that the overall economic structure of the Midwest is showing signs of maturing resulting in an top heavy tertiary economy based on service producing industries. Unless innovation and investment are strengthened, we will see a continue weakening of our economy.

FEDERAL INTERVENTIONS

We believe that the federal interventions must recognize the need to stimulate the additional investment and innovation within both the public and private sectors at the state and local level. Federal interventions must stimulate the rebuilding of the deteriorated public facilities and services, provide additional research and development resources (especially in basic research areas), and result in a workable retraining program to help retool the human capital that is being displaced in some of the mature industries by technological changes (e.g., a trade adjustment assistance program could be a model). In addition, investment tax credits, continuation of industrial development revenue bonds, and a broader program of guaranteed loans would aid the private sector and provide incentives for small business growth and development.

It will require a targeted and balanced economic development strategy at all levels if we are to succeed.

EXHIBIT A

DR. BRUCE B. MORGAN

PROSPECTS FOR ECONOMIC GROWTH

MRI

DR. BRUCE B. MORGAN

EXHIBIT A

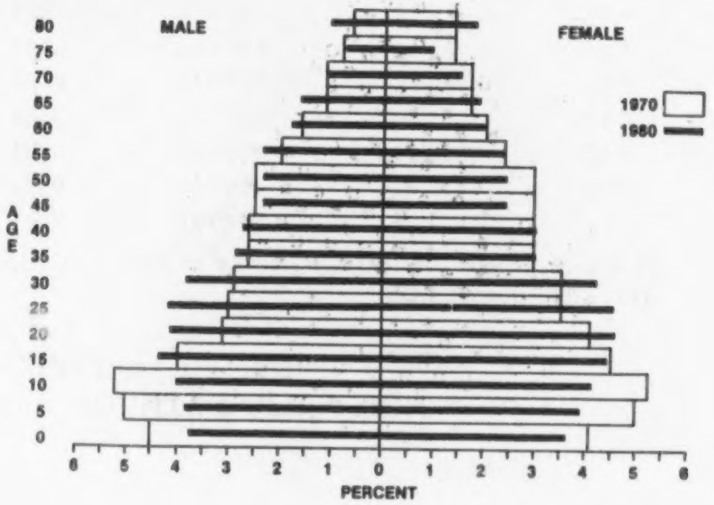
FIVE COUNTY POPULATION TOTALS BY DECADE

YEAR	POPULATION	GROWTH FOR DECADE	PERCENT GROWTH
1890	268,406		
1900	321,620	53,214	19.8
1910	436,609	114,989	35.8
1920	542,799	106,190	24.3
1930	679,474	136,675	25.2
1940	700,505	21,031	3.1
1950	829,330	128,825	18.4
1960	1,062,843	233,513	28.2
1970	1,216,879	154,036	14.5
1980	1,254,613	37,734	3.1

DR. BRUCE B. MORGAN

EXHIBIT A

PERCENT DISTRIBUTION OF POPULATION BY AGE AND SEX



DR. BRUCE B. MORGAN

EXHIBIT A

CENTRAL CORE	VS.	SUBURBAN
MANUFACTURING		DISTRIBUTION
GOVERNMENT		SERVICES
FINANCE		RETAIL
HEALTH/LEGAL SERVICES		INSURANCE

DR. BRUCE B. MORGAN

EXHIBIT A

PERCENT DISTRIBUTION OF U.S. NONAGRICULTURAL EMPLOYMENT BY INDUSTRY

	1950	1960	1970	1980	1982
GOODS PRODUCING					
MINING	2	1	1	1	1
CONSTRUCTION	5	5	5	5	4
MANUFACTURING	34	32	27	22	20
TOTAL	41	38	33	28	25
SERVICE PRODUCING					
T.C.U.	9	7	6	6	6
TRADE	21	21	21	22	23
F.I.R.E.	4	5	5	6	6
SERVICES	12	14	16	20	22
GOVERNMENT	13	15	18	18	18
TOTAL	59	62	67	72	75

DR. BRUCE B. MORGAN

EXHIBIT A

PERCENT DISTRIBUTION OF EMPLOYMENT BY INDUSTRY

	1940	1960	1982
CONSTRUCTION	5 %	5 %	3 %
MANUFACTURING	24	25	18
T.C.U.	12	11	8
TRADE	26	24	26
F.I.R.E.	6	6	7
SERVICES	23	20	23
GOVERNMENT	4	10	15
	100 %	100 %	100 %

EXHIBIT A

PERCENT DISTRIBUTION OF EMPLOYMENT BY INDUSTRY

	U.S.	KANSAS	MISSOURI	KANSAS CITY SMSA
MINING	1	2	—	—
CONSTRUCTION	4	4	4	3
MANUFACTURING	21	18	21	18
T.C.U.	6	7	7	8
TRADE	23	25	24	26
F.I.R.E.	6	5	6	7
SERVICES	21	19	21	23
GOVERNMENT	18	20	17	15
	100	100	100	100

EXHIBIT A

PERCENT DISTRIBUTION OF EMPLOYMENT BY INDUSTRY

	NORTH DAKOTA	SOUTH DAKOTA	WISCONSIN	MINNESOTA	MINNEAPOLIS-ST. PAUL SMSA
MINING	4	1	—	1	—
CONSTRUCTION	7	4	3	4	4
MANUFACTURING	6	11	26	20	21
T.C.U.	7	6	5	5	6
TRADE	26	27	23	25	25
F.I.R.E.	5	5	5	6	7
SERVICES	21	22	21	23	23
GOVERNMENT	24	24	17	16	14
	100	100	100	100	100

EXHIBIT A

DR. BRUCE B. MORGAN

PERCENT CHANGE IN NONAGRICULTURAL EMPLOYMENT

	1977-80	1980-82
U.S.	+10	-2
MISSOURI	+6	—
KANSAS	+9	-3
ARKANSAS	+7	-2
OKLAHOMA	+17	+6
IOWA	+2	-5
NEBRASKA	+6	-3
KANSAS CITY SMSA	+5	-5

DR. BRUCE B. MORGAN

EXHIBIT A

PERCENT CHANGE IN NONAGRICULTURAL EMPLOYMENT

	1977-80	1980-82
NORTH DAKOTA	+7	+3
SOUTH DAKOTA	+6	-3
WISCONSIN	+9	-6
MINNESOTA	+12	-4
MINNEAPOLIS-ST. PAUL SMSA	+12	-2

DR. BRUCE B. MORGAN

EXHIBIT A

PERCENT CHANGE IN NONAGRICULTURAL EMPLOYMENT 1981-1982

	U.S.	KANSAS	MISSOURI	KANSAS CITY SMSA
MINING	-11	-13	+3	-20
CONSTRUCTION	-6	-14	+3	-9
MANUFACTURING	-9	-14	-5	-8
T.C.U.	-3	-2	-2	-9
TRADE	-1	-2	-1	-6
F.I.R.E.	+1	—	—	-2
SERVICES	+2	+5	+3	-2
GOVERNMENT	-1	+2	-1	-1
	-3	-4	-1	-5

EXHIBIT A

DR. BRUCE B. MORGAN

PERCENT CHANGE IN NONAGRICULTURAL EMPLOYMENT 1981-1982

	IOWA	NEBRASKA	ARKANSAS	OKLAHOMA
MINING	-5	-17	-7	-9
CONSTRUCTION	-11	-8	-13	+5
MANUFACTURING	-13	-11	-9	-14
T.C.U.	-6	-8	-1	-3
TRADE	-3	-2	—	+3
F.I.R.E.	—	—	+1	+5
SERVICES	—	—	+2	+6
GOVERNMENT	—	-1	+4	+3
	-4	-4	-4	—

EXHIBIT A

DR. BRUCE B. MORGAN

PERCENT CHANGE IN NONAGRICULTURAL EMPLOYMENT 1981-1982

	NORTH DAKOTA	SOUTH DAKOTA	WISCONSIN	MINNESOTA	MINNEAPOLIS-ST. PAUL SMSA
MINING	-21	-10	-5	-59	—
CONSTRUCTION	-1	-16	-14	-9	-10
MANUFACTURING	-8	-5	-9	-6	-6
T.C.U.	-2	—	-5	-6	-4
TRADE	—	-4	-1	-4	-4
F.I.R.E.	+2	+3	+1	-1	-1
SERVICES	+4	-1	+2	+1	+2
GOVERNMENT	—	+2	-2	-5	-4
	-1	-2	-4	-4	-3

DR. BRUCE B. MORGAN

EXHIBIT A

ECONOMIC BASE CONCEPT

- BASIC VS. NONBASIC
- MULTIPLIER
- INPUT-OUTPUT MODEL

EXHIBIT A

BASIC EMPLOYMENT SECTORS

AIR TRANSPORT	3.89	OTHER RETAIL TRADE	1.47
MOTOR VEHICLES	2.28	PETROLEUM PRODUCTS	1.44
RAILROAD TRANSPORT	2.24	ELECTRIC MACH.	1.39
PRINTING & PUBLISHING	1.98	FEDERAL GOVT.	1.27
FINANCE, REAL ESTATE	1.73	STONE, CLAY, GLASS	1.10
WHOLESALE TRADE	1.54	CHEMICALS	1.09
INSURANCE	1.50	AUTO DEALERS	1.07
OTHER TRANSPORT	1.49	EATING & DRINKING	1.02

EXHIBIT A

DR. BRUCE B. MORGAN

TOP 10 SECTORS BY INCOME MULTIPLIER

AGRICULTURE	3.64	CHEMICALS	2.64
MOTOR VEHICLE	3.17	STATE & LOCAL GOVT.	2.64
FOOD PROCESSING	2.91	HEALTH SERVICES	2.63
PERSONAL & REPAIR SERVICES	2.72	FINANCE, REAL ESTATE	2.50
PETROLEUM PRODUCTS	2.65	INSURANCE	2.35

DR. BRUCE B. MORGAN

EXHIBIT A

OUTLOOK

- SLOWER RECOVERY
- DANGER SIGNS OF LONG TERM STRESS
- NEED FOR SOUND ECONOMIC DEVELOPMENT STRATEGY

DR. BRUCE B. MORGAN

EXHIBIT A

TOP 10 LOCATION FACTORS FOR HIGH TECH FIRMS

LARGE FIRMS (> 100)	SMALL FIRMS (< 100)
LABOR POOL	PROXIMITY TO MARKET
LABOR COST	CITY COOPERATION
EDUCATION/TRAINING	OVERALL COST OF DOING BUSINESS
LIFESTYLE	LABOR COST
LABOR PRODUCTIVITY	LINKAGES/SERVICE INDUSTRY
TRANSPORTATION	ENERGY COST
TAX CLIMATE	FINANCING
PROXIMITY TO SUPPLIER	LABOR PRODUCTIVITY
OVERALL COST OF DOING BUSINESS	TRANSPORTATION
CITY COOPERATION	TAX CLIMATE

DR. BRUCE B. MORGAN

EXHIBIT A

REGIONAL TARGETS OF OPPORTUNITY

- BIOTECHNOLOGY
- ELECTRONICS
- REGIONAL MEDICAL CENTER
- COMMUNICATIONS

EXHIBIT B

DR. BRUCE B. MORGAN

VERY HIGH GROWTH (**) AND HIGH GROWTH (*) HIGH TECHNOLOGY INDUSTRIES

SIC			
28	CHEMICALS AND ALLIED PRODUCTS		
283	Drugs and Pharmaceuticals		
		2831010	Biochemicals (Genetic Engineering)**
		2831050	Recombinant DNA products**
		2831112	Monoclonal antibody based products**
286	Organic Chemicals		
		2868850	Organometals**
32	STONE, CLAY AND GLASS PRODUCTS		
326	Ceramics and related products		
		3264000	Ceramic electrical products*
329	Miscellaneous Nonmetallic Mineral Products		
		3298410	Graphite fibers**
		3298510	Silicon crystals*
33	METALS		
335	Nonferrous Mill Products		
		3357000	Nonferrous wire drawing*
		3357420	Electronics wire*
336	Nonferrous Foundries		
		3369250	Magnesium die castings (M)**
339	Metals NEC		
		3399400	Specialty metals and composites*
34	FABRICATED METAL PRODUCTS		
349	Fabricated Metal Products NEC		
		3494716	Digital control valves*
35	MACHINERY EXCEPT ELECTRIC		
353	Construction and Related Equipment		
		3539100	Industrial robots**
354	Metalworking Machinery		
		3540100	Machine tools**
355	Special Industry Machinery		
		3559351	Injection molding machines**
		3559580	Electronics production equipment**
357	Office and Computing Machines		
		3573020	Small business computer systems**
		3573026	Word processing equipment**
		3573030	Manufacturing computer systems**
		3573036	CAD/CAM**
		3573091	Computer graphics**
		3573095	Energy management computer systems**
		3573098	Personal and home computers**
		3573110	Digital computers (minis)**
		3573210	Memories and storage devices**
		3573220	Semiconductor memories (RAM)**

EXHIBIT B

DR. BRUCE B. MORGAN

SIC		
	3573250	Computer optical and graphics equipment**
	3573270	Terminals**
	3574230	Electronic desk calculators**
	3579702	Voice activated typewriters**
36	ELECTRICAL AND ELECTRONIC EQUIPMENT	
362	Electric Industrial Equipment	
	3621000	Motors and generators*
	3621770	Stepper motors*
	3622000	Industrial controls**
	3629320	Fuel cells and thermic generators*
365	Consumer Electronics	
	3651630	Video disc players**
	3652060	Video discs**
366	Communications Equipment	
	3661220	Telephone carrier equipment**
	3661250	Data communications equipment*
	3662020	Military communications equipment*
	3662060	Aerospace electronics*
	3662070	Marine electronics*
	3662130	Satellite communications equipment*
	3662340	Intrusion detection alarms**
	3662450	Aircraft navigation systems*
	3662480	Missile and space navigational equipment**
	3662500	Electronic search and detection equipment*
	3662510	Infrared surveillance equipment*
	3662520	Electronic countermeasures**
	3662530	Target finding-fire control except radar**
	3662540	Radar systems and equipment**
367	Electronic Components	
	3674110	Integrated circuits*
	3674120	Digital integrated circuits**
	3674140	MOS integrated circuits**
	3674200	Transistors (MOSFET)**
	3674400	Optoelectronic devices**
	3674410	Light emitting diodes*
	3674430	Light sensing semiconductors**
	3674440	Photovoltaic cells**
	3675240	Ceramic fixed capacitors**
	3676500	Printed resistor networks*
	3679120	Magnetic cards*
	3679130	Magnetic discs**
	3679230	Microwave assemblies*
	3679410	Printed circuit board*
	3679520	Keyboards*
	3679580	Display devices*
369	Electrical and Electronics NEC	
	3691500	Storage batteries except lead/acid*
	3693121	Industrial and scientific X-ray*
	3694700	Automotive electronics**

DR. BRUCE B. MORGAN EXHIBIT B

SIC			
38	INSTRUMENTS AND RELATED PRODUCTS		
381	Engineering, Laboratory, Scientific and Research Instruments and Associated Equipment		
		3811120	Gyroscopes (Laser)*
		3811200	Laboratory and scientific instruments*
382	Measuring and Control Instruments		
		3823230	Digital process control equipment*
		3823250	Sequential controllers*
		3823280	General process equipment NEC*
		3823520	Electronic flow and level sensors*
		3825200	Electronic test and measure equipment*
383	Optical and Analytical Instruments		
		3832630	Chromatographic analyzers*
		3832670	Thermal analysis instruments*
		3832700	Fiber optics**
		3832830	Lasers for industrial use**
384	Medical Instruments and Supplies		
		3841010	Electronic medical equipment*
		3841200	Medical monitoring and diagnostic equipment**
		3841270	Medical imaging and scanning*
		3841310	Blood lab analysis equipment*
		3841320	Diagnostic test kits**
		3841510	Diathermy equipment*
		3841520	Ultrasonic therapeutic equipment*
		3841530	Kidney dialysis equipment*
		3841540	Defibrillators*
		3841570	Cardiovascular equipment*
		3841580	Urological equipment*
		3841710	Anesthesia apparatus*
386	Photographic Equipment and Supplies		
		3861202	Intelligent photocopying equipment**
48	COMMUNICATIONS		
481	Telecommunications		
		4811200	Data transmission services**
		4811510	Electronic mail services**
		4811800	Mobile radio services*
483	Radio and TV Broadcasting		
		4834000	Cable television systems*
484	Satellite Communications		
		4841000	Satellite voice communications**
		4843000	Satellite TV communications**
73	BUSINESS SERVICES		
737	Computer Services		
		7372000	Computer software**
		7372120	Packaged software**
		7374000	Data processing services*
		7374110	Time sharing services**
		7375100	Literature retrieval services*
		7375400	Videotext services*
80	HEALTH, EDUCATION AND WELFARE		
		8000420	Diagnostic procedures**

MIDWEST FOCUS

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MARCH 1983

A REVIEW OF ECONOMIC ISSUES BY MIDWEST RESEARCH INSTITUTE

MRI FORUM

With the first issue of MIDWEST FOCUS, Midwest Research Institute is pleased to begin a new dimension in its role of fostering economic development in the nation and the Midwest region.

Since its founding in 1944 by a group of community-minded businessmen, MRI has been committed to the advancement of technology and the growth of the regional economy through its own research efforts and projects for MRI clients in both the public and private sectors. MRI serves an important role by sharing its knowledge and expertise.

With the publication of MIDWEST FOCUS, the staff of MRI's Economics and Social Science Department will regularly share their thoughts on economic and regional issues. We think you will find them both interesting and useful.

John McKelvey
President

ECONOMIC OUTLOOK 1983 — A Year of Opportunity?

by Sheldon W. Stahl, Ph.D.

In spite of the emergence of several positive signs in the economy late last year, there is a notable and uncharacteristic lack of temerity by the Reagan Administration with respect to its official forecast for the economy in 1983. Or, as will be seen in the analysis that follows, an objective assessment of the economy's prospects for 1983 could lead to the conclusion that the official forecast reflects a welcome dose of realism.

Clearly, the performance of the economy in 1982 was a major disappointment. In the *Economic Report of the President for 1982,* real growth had been forecast to rise by 3 percent from the fourth quarter of 1981 to the fourth quarter of 1982. Instead, the real Gross National Product (GNP) fell by 1.2 percent during that period. For all of 1982, real GNP declined by 1.8 percent as compared to the average of the preceding year. This decline equalled that recorded 37 years ago when the nation was in the midst of a sharp postwar adjustment process following the end of World War II, pulling the level of real GNP to below that of 1979. For the overall economy, the capacity utilization rate in manufacturing averaged below 70 percent for the year. The level of industrial production in 1982 fell back to that of 1977, and in such key industries as housing and autos, activity levels continued to recede for much of the year from an already poor performance in the preceding year. Net exports fell by some 23 percent from year-earlier levels, and real capital outlays dropped by nearly 5 percent after a lackluster performance in 1981. And, for all of 1982, the overall unemployment rate averaged 9.7 percent — up sharply from the 7.6 percent average of 1981 — with the year-end rate just shy of 11 percent. Total employment in 1982 was lower than in the two preceding years, and the number of unemployed last year was nearly

continued

twice that of 1979.

In sum, 1982 proved to be a year of great economic stress in the United States and the ripples from here served to worsen the plight of both the industrialized countries of the West and the developing nations as well.

On one front, however, progress was undeniable. The rate of inflation in 1982 decelerated markedly. At the same time, labor cost increases moderated, as did unit labor costs in manufacturing in the face of sharp gains in productivity. In financial markets, both long- and short-term interest rates fell, with the latter falling sharply during the latter part of 1982. At year-end, the prime interest rate was at 11 to 11.5 percent, or 10 points below year peak levels.

Nonetheless, the drop in rates helped to fuel a dramatic stock market rally beginning in late summer and which appears, thus far, to have been sustained. Even the long-depressed housing and auto sectors showed signs of late-year strength in the wake of falling interest rates. Thus, despite considerable economic trauma in 1982, there were some bright spots to be observed.

> **"Without a change in current tax and spending laws, potential deficits of $200 to $300 billion...through 1988."**

THE POLICY ENVIRONMENT

Public policy in 1982 was characterized by considerable ambiguity. Fiscal policy overall, continued to be marked by relative ease. The problem of excessive federal deficits remains to be resolved. At approximately $111 billion, the fiscal year 1982 deficit represents a significant erosion from the $69 billion deficit in 1981. But, prospective deficits in the current and successive fiscal years provide even greater cause for alarm and gravely complicate the public policymaking process. For, without a change in current tax and spending laws, potential deficits in the range of $200 to $300 billion may await us through Fiscal Year 1988, and the economy could again fall victim to a divergence in the conduct of monetary and fiscal policy.

The sharp drop in interest rates in 1982 was a direct result, in part, of the weakness in the economy and the decline in overall credit demands in the private sector. However, it also was the result of a conscious and aggressive policy of easing on the part of the Federal Reserve System. Although such actions were welcome in the light of domestic and worldwide recession, they were undertaken in the shadow of enormous federal budget deficits, and at considerable future risk. Treasury borrowing requirements in the $50+ billion range each quarter for the next several years will absorb the bulk of net private savings generated in the economy, and will thereby exert persistent upward pressure on interest rates. Yet, any attempt to fully accommodate private and public credit demands on the part of the Federal Reserve would result in rekindling inflationary fears and expectations. In such an environment, interest rates would once again reflect high inflation premiums and move up rapidly. And, the stronger is the economic recovery, the more pronounced would be the upward pressure on rates.

For this reason, the need for a truly bipartisan response to our fiscal crisis is paramount in setting the stage for future healthy, sustainable economic growth both here and abroad. It is this consideration which, if grasped, poses an opportunity for the economy.

1982 ECONOMIC PICTURE

REAL GNP	**−1.8%**
NET EXPORTS	**−23%**
REAL CAPITAL OUTLAYS	**−5%**
UNEMPLOYMENT	**9.7%**
CAPACITY USE	**70%**
PRODUCER PRICE INDEX	**+4%**
CONSUMER PRICE INDEX	**+6.1%**
PRIME RATE	**14.86%**

THE ECONOMIC OUTLOOK

Even with fruitful efforts on the fiscal problem, the growth prospects for the economy in 1983 remain muted. This was reflected in the official forecast by the Administration of a 3.1 percent gain in real GNP from the fourth quarter of 1982 to the fourth quarter of 1983, or for an annual average gain of 1.4 percent. Although this estimate might be on the low side of the forecast range for 1983, it is far from unrealistic. At year-end 1982, the economy still had little momentum. The decline in interest rates had led to a late-year pickup in housing and auto sales, but any further gains in these interest sensitive sectors clearly depend upon a much improved financial environment. The improvement in both the stock market and in the bond market restored much of the earlier erosion in net worth that had occurred. And, consumers, after reducing outstanding installment indebtedness, had improved their financial positions overall, as well. Business inventories had been pared dramatically, but were still burdensome. Thus, the year 1983 opened with a greater potential for growth than was the case a year ago, but with no assurance that this potential would be realized.

"A more modest recovery is predicted."

As always, the overall strength and persistence of any economic recovery and growth is, in large measure, a function of public policy initiatives yet to be set forth or implemented. Given the scope of our economic problems, even under optimistic policy assumptions, progress will be gradual and only modest results should be expected for 1983. Such a view is buttressed by an examination of the key demand sectors in the economy.

As noted above, consumers have managed to improve their ability to take on additional indebtedness and expand spending. Auto sales, for instance, after showing strong gains associated with low-rate financing incentives, appear to have stalled out. Nonetheless, a modest improvement in 1983 auto sales to a range of 6 to 6.5 million domestic units sold, from 5.7 million units in 1982, is well within grasp. At the same time, housing starts, similarly depressed for three years, could add strength to a recovery. If overall interest rates do not rise precipitously, and if mortgage rates stabilize at or near present levels, then a level of starts in the 1.3 to 1.4 million range is attainable. Such a gain, albeit modest, would be the first gain since 1979 and would help stimulate the sale of other consumer durables such as furniture and appliances.

In the investment sector, other than housing, nonresidential construction is still under stress with ongoing reports of scattered softness in office and industrial building. Any strength from this sector would be minimal at best. Finally, with real capital outlays having fallen sharply last year, any early hopes for a turnaround in 1983 are hard to come by. In the light of extraordinarily large amounts of unused capacity in manufacturing, this should come as no surprise. In fact, preliminary surveys of plant and equipment spending plans for 1983 indicate that real capital outlays this year will fall by 5.2 percent — an even larger drop than in 1982. Thus, investment incentives notwithstanding, a cloud of excess capacity dims any likelihood that capital spending will add strength to the recovery this year.

"The stronger the economic recovery, the more upward pressure on interest rates."

Turning to the foreign trade and government sectors, the prospects for stimulus are mixed. A combination of a relatively strong U.S. dollar which makes exports from the U.S. unattractive, weak overseas markets associated with depressed foreign economies, and a modest rise in imports in the U.S. as our economy begins to grow all point to the net export sector serving as a drag on the economy this year. At the same time, overall federal outlays will rise, paced by sharp gains in defense spending and modest gains in nondefense outlays. At the state and local government level, there are clear impediments to large spending increases. Real grants-in-aid from the federal government have fallen quite sharply in recent years, and the effects of recession and a reduced tax base have combined to place these governmental units under great fiscal stress. Thus, the contribution of state and local government spending to any recovery in 1983 will be quite small by historical standards.

Overall, 1983 is not likely to erase all the damage wrought by the recession. After a slow start, growth may improve in the latter half of the year. Nonetheless, for the year as a whole, real gains in GNP will likely fall within a range of from 1.5 to 2.5 percent. Because this forecast represents a very mild recovery at best, the implications for the unemployment picture are not at all good. With some re-entry of current discouraged workers adding to normal labor force growth when the economy begins to recover, the overall unemployment rate will remain uncomfortably high in 1983, averaging well above 10 percent for the year.

If there is a silver lining in the cloud of a weak recovery, then it is to be found in the prospects for inflation. Some of the same forces that helped moderate wage and price inflation last year will again be at work in 1983. The weakness in oil prices and in food and farm prices will again help to dampen inflation. Thus, consumer prices should again rise by an average of 5 to 6 percent for the year as a whole. Similarly, the rise in labor costs should approximate that of last year as well. With labor markets continuing to be marked by slack, and with the contribution of cost-of-living escalators reduced vis-a-vis past years, not even the large collective bargaining calendar is likely to push the overall rise in labor costs in 1983 much beyond 6 to 6.5 percent.

continued

"1983 is not likely to erase all the damage wrought by the recession."

No forecast of economic variables has proven to be as tenuous in recent years as that having to do with interest rates. The deficit problem alluded to earlier only adds to the air of uncertainty. No one can safely predict the end product of the budget debate now getting underway, nor can the response of the Federal Reserve be predicted with a high degree of certainty. Yet, the pressure of the very large deficit now anticipated for the current fiscal year along with even modest growth in private credit demands suggests that a moderate rise in both long- and short-term rates is to be anticipated over the course of the year.

SOME CONCLUDING OBSERVATIONS

If there is any real lesson to be learned from forecasting, it is that humility should be the forecasters constant companion. In 1982, for example, the economy proved to be far weaker than Administration forecasters had predicted. As a consequence, the Federal Reserve moved much more aggressively towards ease than our fiscal situation might otherwise have dictated. The size of the deficits now envisaged for the current year and beyond should limit the degrees of freedom of the monetary authorities to repeat their easing act of last year. Given the prospects both for economic growth and inflation this year, any rise in interest rates should be contained within a narrow range. However, as noted above, surprises do happen often enough that prudent planners must give them consideration in evaluating any forecast. If economic growth proves to be far more robust than has been estimated here, one should anticipate a prompt move towards restraint by the Federal Reserve with a corresponding upward push on the behavior of interest rates. Thus, a very strong recovery, paradoxically, could prove to be short-lived.

"It is unlikely that job gains in 1983 will be substantial."

In the period ahead, the stakes for the American economy and for the world at large are enormous. Hard choices remain to be made by the President and by the Congress regarding defense outlays, taxes, indexing, and entitlements, just to name a few areas of contention. For the failure to come to terms with our fiscal crisis will have ramifications far beyond our own borders. Compounding this danger is the fragility of the whole international financial system and the prospects for massive international defaults. The world economy will be sorely tested in 1983 and beyond. Even if a cyclical recovery does get underway, many long-term structural problems will remain to impede our progress towards a truly healthy U.S. economy, as well as a healthy world economic system.

It is in that context, and in the recognition of international economic interdependence, that attention to our economic ills can no longer be deferred. We have before us an opportunity to begin to address in a meaningful way those problems which beset us. Hopefully, neither partisanship nor ideological rigidity will let this opportunity slip from our grasp.

"The weakness in oil, food, and farm prices will again help to dampen inflation in 1983."

MRI

Dr. Stahl is the Senior Economist at Midwest Research Institute.

IS THERE A HIGH TECH FIRM IN YOUR FUTURE?

by Linda W. Thornton

"High tech" is the subject of intense interest among economic developers across the country seeking new businesses and job opportunities for their areas.

No Midwestern state lacks a brochure extolling that state's virtues as a breeding ground for high technology firms. Every politician seeking office promotes a plan to lure these clean industries to depressed urban areas.

Obviously, high technology firms cannot provide relief for every city suffering economic dislocation. But there have been successes in attracting high tech firms to areas outside the now-congested high technology pockets on the East and West Coasts. Several recent studies have documented that there are specific high tech industries that are well-suited to Midwestern locations.

One such study was recently completed by MRI for a large Midwestern city as part of its high technology development plan. MRI analysts screened more than 400 high technology industries for growth potential and site selection criteria.

Labor costs are the single most important factor in site selection for high technology firms across the country, according to the MRI study. Availability of labor, education and training institutions, lifestyle, overall cost of doing business, tax climate, linkages to service industries follow in the list of criteria. On the average, environmental regulations, city cooperation, and land availability and cost come last in the list of top ten priorities.

MRI also found that, in the Midwest, criteria are different for large firms than for smaller ones. Availability of highly technical labor such as electrical engineers, labor productivity, education and training institutions, and lifestyle are much more important to large firms than to smaller ones. For smaller firms, linkages to other industry services and supplies, energy costs, environmental regulations, financing, and land availability and cost are much more critical than for the large firms.

"There are specific high tech industries well-suited to Midwestern locations."

MRI screened more than 400 high technology industries for growth potential and site selection criteria. Then, MRI analysts further screened the high technology industrial groups by matching individual location needs with local industrial attributes. The matrix used four local requisites to determine prospect industries — industry growth, labor intensity, capital expenditures, and industry concentration — and six local attributes which could attract potential industries — labor cost, energy cost, linkages available, professional labor availability, lifestyle requirements, and environmental regulations.

A total of 26 industries met criteria for the metropolitan area under study. The key industries for this particular area included digital control valves, industrial robots, automotive electronics, electronic production equipment, terminals, industrial controls, data communications equipment, and various communications and navigation equipment.

This city's timing for targeting marketing toward the designated industries is excellent. A recent study by the Joint Economic Committee of the U.S. Congress showed that many of the 700 high technology firms surveyed were planning relocations or expansions outside the East and West Coasts. The firms reported that their growth in present locations was being restrained by shortages of skilled labor, housing costs, congestion, and insufficient room for expansion.

As high technology industries mature, and competition becomes keener, they are increasingly likely to seek lower cost regions which can offer attractive industrial incentives geared for production facilities. Now may be the best time to evaluate what your region can best offer and to whom.

MRI

Ms. Thornton is manager of MRI's Economics and Financial Analysis Section.

MOVING FORWARD:

Prospects For Economic Growth in Kansas City

by Bruce B. Morgan, Ph.D.

Biotechnology, electronics, medical services, and communications should be targets for economic opportunity in Kansas City in the next decade.

For the future, Kansas City must develop an aggressive business retention program to keep firms in the area. In addition, civic leaders need to work with private and public sector representatives to encourage new ventures in these four target areas to capitalize on regional advantages and spawn new economic growth.

"Small businesses represent the greatest potential."

The decade of the 1970s witnessed the rapid transformation of the U.S. economy from an industrial/manufacturing base to an information/service base. Consequences of this change are only now beginning to emerge, but it is clear that the 1980s and 1990s will present new challenges to the regional as well as the national economy.

Kansas City has strong advantages to overcome its current economic slump. Its centralized location relative to major markets is one key to growth. The geographic center of population in the United States is now located in Missouri, just outside of St. Louis.

Kansas City is served by all major highway systems. It represents a major rail center as the fourth largest freight car handling center and has a large airport. These facilities put the city in a good position to serve those areas in the southern and western sections of the country targeted for the greatest growth in the coming decade.

The region also offers a good quality of life, a factor increasingly important to firms in their site selection criteria. And, high technology industries in Kansas City are growing. These include services and products in health care, communications, electronics, agribusiness and energy.

The University of Kansas, Kansas State University, the University of Missouri at Columbia and Kansas City, and MRI are leaders in the development of biotechnology in areas ranging from medicine to alternative fuels to new agricultural techniques. These institutions offer resources and scientists that could grow a biotechnology industry in this region.

Electronic developments do occur outside California's Silicon Valley and Route 128 near Boston. Kansas City's Wilcox Electric plan makes most of the instrument landing systems used in the world today. This firm also holds a contract to build a microwave landing system which is likely to be the new state-of-the-art for most major airports.

Other electronic developments are going on at King Radio, one of the largest manufacturers of general aviation avionics, and at firms like Western Electric and Bendix.

Smaller, spin-off firms have already begun here. Birdview Satellite Communications was recently created here to build an integrated home earth station for satellite communications.

Kansas City also has some of the finest medical care available, with potential to expand as a regional medical center. St. Luke's Hospital has one of the most outstanding cardiovascular teams in the country, on a par with those in Houston, Cleveland, Boston, or the Mayo Clinic.

The University of Kansas Medical Center here offers the most current and sophisticated cancer care available. Its staff, facilities, and research programs are comparable to centers such as M.D. Anderson in Houston or Sloan-Kettering in New York.

Another area of opportunity is communications. Communication and computer industries here are already spawning new firms. United Telecommunications recently established a major satellite group here. UTS also has a major communications group interfacing with highly sophisticated, computer facilities around the country.

New, small businesses in these target areas represent great potential for economic growth in Kansas City. Firms with less than 20 employees accounted for two-thirds of the new jobs created in the last decade throughout the country, according to a recent study by the Massachusetts Institute of Technology. MIT looked at more than 4 million firms to find that as much as 80 percent of new jobs were generated by firms with less than 100 employees that had been in business less than 4 years.

KANSAS CITY TARGETS FOR GROWTH

- **BIOTECHNOLOGY**
- **ELECTRONICS**
- **MEDICAL SERVICES**
- **COMMUNICATIONS**

More importantly, almost 90 percent of the new jobs were in the services sector. Growth in manufacturing accounted for 8 percent of the total new jobs created and did not offset the losses.

Although small businesses present some special challenges because of financial stability, capacity, and the high rate of failure, new business starts have continued to increase even during recessionary times.

Kansas City clearly is suffering from a certain degree of economic distress which could lead to a crisis in some areas. The Chinese write the word "crisis" with two symbols or characters: one means danger and the other means opportunity. In crisis, people seem to recognize the danger. Kansas City also needs to see the opportunity.

Today's economic problems are far from insurmountable. We must pool resources, share information, and join forces to develop an aggressive, specific program to help businesses already here and encourage the start of new ones.

MRI

Dr. Morgan is director of MRI's Economics and Social Sciences Department.

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A REVIEW OF ECONOMIC ISSUES BY MIDWEST RESEARCH INSTITUTE

STRUCTURAL BARRIERS TO ECONOMIC GROWTH

by Dr. Sheldon W. Stahl

As each new fragmentary bit of information on the condition of the economy is released, the debate has shifted from concern over when the recession would end, to speculation over the strength and durability of the cyclical recovery. A growing number of professional economy-watchers suggest, with somewhat more confidence, that December, 1982 may prove to have been the trough, or bottom, of this most recent business cycle decline. And, in the face of such infectious, if not altogether unrestrained optimism, the official Administration forecast of real economic growth for 1983 has been revised upward.

As with all prior recessions, there seems to be a recognition that the ravages of recession will take time to heal, but there is a sense of relief that the healing process has apparently begun. Yet, even with signs of cyclical upturn more in evidence, for many there is a profound sense of unease over the longer-term prospects for the well-being of the American economy. This article will review the source of this unease...a series of fundamental and troubling structural barriers to economic growth.

DIMENSIONS OF THE PROBLEM

A look at the overall growth record in recent decades provides a sense of perspective from which to assess the prospective performance of the American economy in the decade of the 1980's.

In the 1950's, real economic growth averaged 3.9 percent per year. Twice during that decade real growth was well over 8 percent per year, and, twice it was 6 percent or more. In the decade of the 1960's, growth averaged 4.1 percent — a modest rise — but in only two years was real growth as high as 6 percent per year. The 1970's brought with it a dramatic slide in the overall performance of the economy. Real economic growth averaged only 2.9 percent per year, and never reached or exceeded 6 percent. In further contrast with the 1960's when real GNP rose every year, real GNP fell in 1970, 1974, and 1975. Thus far, the record of the 1980's is most discouraging. Real GNP fell both in 1980 and in 1982, and in 1981 the economy grew by less than 2 percent.

The same pattern of declining performance was evident in the behavior of productivity and unemployment over roughly the same period. From 1948 to 1968, the annual average rate of productivity gain was 3.2 percent. In the period from 1968 to 1973 it fell below 2 percent. And, for the remainder of the

> **"The decline in U.S. competitiveness in the '70s resulted in a loss of $125 billion in output and $2 million industrial jobs."**

continued

1970's, annual gains in productivity fell well below 1 percent. This erosion was mirrored in a rising average rate of unemployment decade by decade, from 4.5 percent in the 1950's, to 4.8 percent in the 1960's, to 6.2 percent in the 1970's, and to over 8 percent since 1980.

The shortfall in the economy's performance in the past two decades can be traced to an increasing loss of competitiveness in our industrial base. In 1960, the United States supplied more than one-fourth of all manufactured goods exported by the industrialized nations. Within a decade the U.S. share of the world market for manufactured goods had fallen 16 percent; and during the 1970's that share fell an additional 23 percent. And beginning in about the mid-1960's, imports began to claim an increasing share of the U.S. market. The erosion in our trade position during the 1970's occurred even as the U.S. dollar's external value was falling by approximately 40 percent — a development which lowered the effective price of U.S. exports and raised the price of U.S. imports. In any event, the practical consequence of the decline in U.S. competitiveness in the 1970's was a loss of $125 billion in output and some two million industrial jobs in this country. In looking ahead to the remainder of this decade, then, the legacy of past performance of the economy weighs heavily. But the question remains, to what can one attribute the loss of U.S. competitiveness noted above?

A LIST OF VILLAINS

In any iteration of the causes of U.S. industrial decline, certainly OPEC is alluded to quite often. To the extent that the average age of the U.S. capital stock vis-a-vis that of our principal competitors in Western Europe and Japan was older and less energy-efficient, our manufacturing productivity would have been more seriously impacted. But our competitors are far more dependent on oil imports than we are. Thus, while OPEC and rising energy costs do share part of the blame for the erosion in U.S. economic performance, they provide only a part of the answer.

At the same time, important structural changes were occurring in our labor market which contributed to our poor productivity gains and our reduced competitiveness. During the past two decades, growth in the U.S. labor force accelerated greatly and the average age and experience level of workers fell. This was attributable to two related demographic phenomena. The first was the "coming of age" of the post-World War II baby boom, and the second was the dramatic rise in the participation of women in the labor force. Following the end of World War II and continuing into the early 1960's, the nation experienced a sharp rise in the birth rate. This new generation of workers entered the labor force in increased numbers during the 1960's and the 1970's. In the 1950's the civilian labor force had increased at an average annual rate of 1.1 percent. This rose to an average of 1.7 percent in the 1960's, and rose sharply again in the 1970's to an average annual rate of 2.5 percent.

"During the past two decades, growth in the U.S. labor force accelerated greatly while the average age and experience level of workers fell off."

Insofar as the female participation rate was concerned, the entry of women into the labor force caused the rate to rise from 34 to 39 percent between 1950 and 1965. But, by 1980, it had soared to 51 percent. The combination of record numbers of new and inexperienced workers caused a fall in the cost of labor relative to other inputs such as capital and a shift towards the substitution of relatively cheaper labor for the more expensive capital. This shift, combined with the ongoing transition from manufacturing to services employment, had an adverse impact on productivity gains.

Some have suggested that a failure to maintain an adequate rate of capital investment is a prime reason for the economy's increasingly poor showing. But, Gregory Schmid, writing in the January-February 1981 issue of *Challenge*, questions this view. He points out that, while the growth in real investment per worker did fall rapidly in the 1970's in the face of rapid labor force growth, overall investment held up quite well. Real investment as a percentage of GNP fell only slightly during the mid and late 1970's. Even allowing for this modest decline, it was higher in the latter part of the decade than it was during the period 1948 to 1965 — a period of stronger overall economic growth. Thus, Schmid concludes that,

> Given the fact that the relative cost of capital rose dramatically during the 1970's, the basic stability of real investment is impressive.

It is generally acknowledged that, during the current decade, demographic trends will result in improved productivity in the labor force. Labor force growth is expected to slow considerably and the average age and experience level of workers will rise. At the same time, as labor force growth slows, if the rate of capital investment rises from its current cyclical low and grows no faster than it did prior to the recession, the capital-labor ratio will rise automatically. While these developments would benefit productivity, they also provide cause for concern. For a consequence of the rising average age and experience level of the labor force is a decrease in its flexibility. Older, more experienced workers, particularly those in two-earner families are often much less flexible in changing jobs, industries, occupations or locations. Thus, as will be noted below, at a time when flexibility in adjusting to new patterns of labor demand will become increasingly important for assuring a higher rate of economic growth, the adjustment process may be hampered by immobility of workers.

"During the current decade, demographic developments will tend to work towards improved productivity."

In the search for villains to explain the disappointing performance of the American economy, the list of candidates could be expanded, but some of the candidates share less of the blame than generally supposed. For example, government regulations have often been cited as playing a key role. However, Robert B. Reich writing in the *Atlantic Monthly* of March 1983 suggests otherwise. While acknowledging that the environmental laws did require firms to invest in new equipment, he points out that those added costs were modest. During the 1970's, the steel industry spent about 17 percent of its annual capital investment budget to reduce pollution and improve worker safety. Of this amount, Reich adds, 48 percent was subsidized by state and local governments through industrial development bonds. During this same period, European competitors matched these outlays, while Japanese steelmakers spent considerably more for these purposes. For the economy overall, according to Reich, combined capital outlays on pollution control and safety have not exceeded 6 percent of industrial investment and account for no more than one-tenth of the slowdown in productivity alluded to earlier.

The role of government deficits in crowding out private investment, at least during the 1970's, also appears to have been overstated as a factor in explaining declining productivity gains and poor economic growth. Throughout much of the 1970's, the deficit as a percentage of our GNP was greatly exceeded by that of such countries as Japan, West Germany, and France. Each of these countries still managed to record higher productivity advances gains than did the United States. As with other oft-mentioned factors, the explanation for this country's economic malaise must be sought elsewhere.

"The role of government deficits in crowding out private investment in the '70s appears to have been overstated."

ANOTHER EXPLANATION

A more plausible explanation of our economic predicament may be found in the way our industrial system is organized. How is the country and its economy equipped to face the growing worldwide competition we confront? Reich writing in both the March 1983 and April 1983 issues of the *Atlantic Monthly*, addresses this question directly:

> The American industrial system that reached its full flower in the postwar era was organized around the principles of high volume and standardization. ...As the trusted formula has ceased to work, America has been ready to embrace any explanation but the most obvious: the same factor that once brought prosperity — the way the nation organizes itself for production — now threatens decline. ...The central problem of America's economic future is that the nation is not moving quickly enough out of high-volume, standardized production. The extraordinary success of the half-century of the management era has left the United States a legacy of economic inflexibility. Thus our institutional heritage now imperils our future.

A major element that assured the success of those firms engaged in mass production was the size of the firm. To gain a competitive edge, firms had to be large enough to take advantage of economies of scale. As a result, in many of our basic industries such as steel, autos, rubber, electrical and non-electrical machinery, the firms became bigger but fewer in number. In technical terms, the industries of which they were part became oligopolistic — that is, composed of three or four dominant firms

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which exhibit rigidity in their pricing policies. At the same time, their management was hierarchical and directed towards minimizing innovation and maximizing short-term profitability within a relatively secure and large captive domestic market.

Beginning in the late 1960's, however, the nature of the global competitive battle began to change and the impact would be increasingly felt here at home. What had begun as a gradual process in the 1960's became a major structural realignment. Mass production, assembly operations involving standardized products, were being established in developing countries at a rapid pace, and the traditional industrial base of our economy was being dramatically undercut. In retrospect, what seems astonishing is the failure of our business leaders to acknowledge and to address this phenomenon and its implications constructively. As early as 1968, Peter F. Drucker had published a remarkably prescient book entitled "The Age of Discontinuity." In it, he comments on the deficiencies of those who regularly engage in technological forecasting and makes a telling observation,

"Faced with growing competition from developing nations and more technologically innovative countries, American industry proved to be unprepared."

> ...major expansion of the economies of the industrially developed countries, both those of the West and those of the Communist world, cannot be carried any further by the industries and technologies that have provided the dynamics of growth for the last one hundred years. In the developed countries, these industries have become "mature" industries, the economist's euphemism for incipient senility. Only in underdeveloped or developing nations can these industries provide the technological foundation for rapid and extensive economic growth.

Faced with both growing competition from developing nations, and more technologically innovative and price competitive offerings from Europe and Japan, American industry proved to be unprepared. The hard, costly decisions to invest in restructuring to meet the competition and to exploit new opportunities in a world market were deferred. Rather, many sought help from government in the form of import protection through voluntary restraints or quotas, or by other means. Thus, as we entered this decade, we had failed to meet the challenge posed by global economic competition. But the issue could no longer be deferred in the face of the costs it was exacting from our economy. In a special issue of *Business Week* dated June 30, 1980 entitled "The Reindustrialization of America," the seriousness of our dilemma was broached in unmistakable terms:

> The U.S. economy must undergo a fundamental change if it is to retain a measure of economic viability let alone leadership in the remaining 20 years of this century. The goal must be nothing less than the reindustrialization of America....

Reindustrialization will require sweeping changes in basic institutions, in the framework for economic policymaking, and in the way the major actors on the economic scene — business, labor, government, and minorities — think about what they put into the economy and what they get out of it. From these changes must come a new social contract between these groups, based on a specific recognition of what each must contribute to accelerating economic growth and what each can expect to receive.

"A cyclical recovery will not remove the barriers to future growth that are at the root of our economy's poor performance."

INDUSTRIAL POLICY: A NEW APPROACH?

It should be clear by now that a cyclical recovery in our economy will not remove the barriers to future growth that are at the root of our economy's poor performance in the world arena. The fact that the United States is not alone in facing this competitive threat should help us in learning how other countries have successfully met it. For example, Japan and other industrialized countries in Western Europe have also confronted the challenge of low-wage production of high-volume standardized products from the developing countries. Their response has been to shift their industrial structure towards those products or processes requiring highly skilled workers. What characterizes these products is that they tend to be technologically innovative, require a high degree of precision in their manufacture, and are highly customized. In short, they tend to be everything that much of our ossified industrial structure is ill-equipped to produce. In place of mass production, they require a more flexible system of production. Instead of a hierarchical management structure geared to routinization and short-term horizons, they need a leaner and more democratic style of management equipped to solve problems and to think and plan long-term.

This does not mean that a wholesale abandonment of our older industries is inevitable or even feasible. Here again we can learn from our competitors.

"A wholesale abandonment of our older industries is neither inevitable nor feasible."

Faced with a similar threat, they have learned to shift both capital and labor to the highest valued and most competitively viable segments of those industries. Such a shift takes time and is not without cost to those involved. Labor fears the loss of jobs in the transition, and business is reluctant to make the long-term investment decisions that carry high risk and involve long payback periods. What is needed, as *Business Week* made clear, is sweeping change in basic institutions and relationships.

One response to this dilemma is a national "industrial policy." This might provide a vehicle for promoting compromise and consensus as to the equitable allocation of the costs and benefits of restructuring the economy. An industrial policy would build on the principles of development economics and expressly recognize that varying conditions and prospects among industries create differing priorities and opportunities for public policymaking and for national economic development. It would clearly imply the notion of "targeting" assistance or denying assistance to different sectors of the economy to help meet the challenges of economic adjustment and economic conversion.

"A national industrial policy might provide a vehicle for promoting equitable allocation of costs and benefits of restructuring the economy."

To some, picking winners or losers in the economic process represents a new and potentially dangerous extension of governmental power in determining the outcome of the economic contest. But past government involvement in the economy has not been neutral. Industrial policies have long been operative in the economies of a number of our major international competitors with good results and without dramatically altering the essential democratic character of those societies. Surely in our own country, such a policy tool could be shaped to avoid any untoward intrusions into those areas where there is consensus that the role of government should be more limited.

A FINAL NOTE

To improve our disappointing economic performance and to assure more durable national economic development, a new and lasting public/private partnership will have to be forged. The place to begin is with a recognition that our problems are rooted deep in the structure of our economy and that a major restructuring will likely be needed. For, as Peter Drucker reminds us:

> Now, however, we face an Age of Discontinuity in world economy and technology. We might succeed in making it an age of great economic growth as well. But the one thing that is certain so far is that it will be a period of change in technology and in economic policy, in industry structures and in economic theory, in the knowledge needed to govern and to manage, and in economic issues.
>
> While we have been busy finishing the great nineteenth-century economic edifice, the foundations have shifted under our feet.

MRI

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A TARGETED APPROACH TO ECONOMIC DEVELOPMENT

by Linda W. Thornton

Major shifts are occurring in the U.S. economy. These shifts are having major impacts on individual cities, regions, and states. Understanding these shifts and their impacts is essential to effective economic growth and development.

SHIFTS OCCURRING IN ECONOMY

Midwest Research Institute, in a series of studies done for the Office of Economic Adjustment in the late 1970's, documented three shifts which were occurring. They are: (1) a structural shift, (2) a spatial shift, and (3) a resource shift.

A structural shift is occurring as the U.S. moves into what some have called a "post industrial economy." The industrial states of the Midwest have been disproportionately affected by the evolution of the national economy from a manufacturing-based to a services-based economy. Many industrial firms have not kept pace with technological changes within their industry and have failed to make the necessary investments to upgrade production facilities. The obsolescence of these firms' manufacturing plants have made the industrial Midwest less competitive in the national marketplace. The result, as has been well documented in the last five years, has been a decline in productivity and output for the industrial Midwest states as a whole and the ultimate loss of a job base which may never be replaced.

A spatial shift is occurring as industry services and population move from former core industrial areas into other regions of the country. The population migration to the South and West in the last decade has been widely reported. In the short and long term, this redistribution of economic activities and population will have a significant impact on non-Sun Belt states.

A resource shift is occurring as the resource-rich regions of the country acquire significant advantages over regions that depend on the importation of these resources. For example, shortages in energy supplies have begun to undercut the advantages the older regions once enjoyed, particularly in the industrial Midwest. As a result, northern and midwestern cities are having difficulty in attracting and generating new industrial activities which require large amounts of energy as part of their production process.

These three major shifts in economic activity have been gradual, occurring over the last decade. However, the effects of the recent recession with major plant closings or reductions and attendant job losses, have created a highly competitive situation between city and state economic development groups to attract compensating economic activity to their area. While there is no question that the increase in efforts on the part of economic development groups can be beneficial to any area, economic development activities are most effective when undertaken with an informed, planned, and targeted approach.

Targeted economic development approaches are most effective.

PRE-PLANNING IS CRITICAL TO SUCCESS

Understanding the structural and other shifts in the national economy and the assets and limitations of one's local economy is critical in structuring an environment attractive to new and expanding industries. For example, a 1980 study documenting the importance of general location factors in Arkansas showed that civic interest groups were unaware of

SHIFTS IN ECONOMY AFFECTING ECONOMIC DEVELOPMENT

Structural shift = Permanent job loss
Spatial shift = Job redistribution
Resource shift = Regional differences in resources

What are the assets and limitations of the local economy?

the locational criteria manufacturers considered important in plant locations. Obviously, if these groups are generally uninformed on the criteria that are key to relocating manufacturers, their effectiveness in a competitive situation is severely diminished.

Planning is also an important element in enhancing an area's economic activity. In the last two decades, most cities and states have allocated all of their development resources to attracting new industrial development. Industrial promotional activities have been almost solely geared toward new manufacturing rather than business or administrative types of activities.

Two statistics bring into question the wisdom of this emphasis on new manufacturing locations. An average of about 80 percent of all economic growth across the United States is attributed to the expansion of *existing* local industry. Secondly, 65 percent of the new jobs created in the last decade were in the *services* industry while many communities were experiencing net losses in the manufacturing sector.

Lost manufacturing employment need not be replaced with *new* manufacturing employment in order for a city to be economically vital. Manufacturing employment losses can often be effectively replaced through expansion of existing industry or with new or expanding technology and service-oriented industry.

Expansion of existing industry contributes about 80% of new jobs.

The retention of existing manufacturing and business activities cannot be overemphasized. Cities are only recently starting to put resources into this important activity. An active and effective retention program is not only beneficial to keeping existing business and industry in the local area, but also serves as an attractor for generating new industry. These new industries will perceive the community as pro-industry. Business retention programs can also fill specific needs such as assistance with financing, labor, environmental regulations, public relations, and land and facility needs, all particularly important for small, expanding companies. Such programs also represent an excellent mechanism for economic developers to keep informed on the responsiveness of the community to individual industries and to provide an early warning system for those companies who may be considering a new location outside of the community.

Business retention is also important.

TARGETING FOR ECONOMIC DEVELOPMENT

Most important of all, cities must target economic development activities. The targeting process should identify firms most beneficial to the general economic development goals of the community, as well as companies likely to be attracted to that location. In this way, communities can make the most successful use of financial and human resources.

MRI has been performing target industry analysis for both manufacturing and business related industries for more than 15 years. The process has been used for both large and small

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communities and has been adapted for unique situation areas such as foreign trade zones, the attraction of high technology activity, and corporate acquisitions and mergers.

The target industry analysis involves identifying industries which are growing and expanding and likely to be looking for new locations. The process also includes a locational analysis identifying those industries which would likely locate in the specific area based on regional factors such as site availability, labor force size and quality, and transportation network. The final step in the process is the identification of specific companies within those targeted industries. Depending upon the location of the area and its attributes, the companies identified could be domestic or international firms or business or manufacturing firms.

Undertaking an economic development program can be costly in terms of both monetary and human resources. However, the price of not competing can be a continuing decline in local economic base. Therefore, a community's commitment to economic development should be optimized by including an understanding of the external shifts which can impact local efforts, a planned approach to economic development, and finally a very specific target of those manufacturing and business groups both new and local which can be most beneficial to the community in the long term.

MRI

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SETTING THE COURSE FOR SURVIVAL

by Dr. Robert C. Bonhag

The business issue of the 1980's is survival. During the 1970's, it was relatively common to expect fast growth in business. As a result, much management thinking focused on short-term growth prospects and objectives. However, the realities of this decade require us to think about a different set of factors. We must begin to focus on longer term approaches which will *ensure* long-term business survival.

A basic management issue today is how to balance the daily operations problems with strategic planning for the longer-term. Far too many companies are operating on the philosophy of assured fast growth when the economy demonstrates that is no longer the case.

But how does a business manager step away from daily operations long enough to focus on the longer term survival issues? The answer is that we can no longer afford not to. It is time to change the job requirements of the chief executive officer and other senior managers to ensure that adequate time is available to continually review operations from a long-term perspective. Within the last few years, chief executive officers have allocated more time to internal operations than to external activities.

We believe that the chief executive role should include being the senior long-term thinker. However, many chief executive officers are still compensated based upon short-term goal attainment for their companies. Corporate boards must assume a role in changing the measurements of success of its senior managers. Long-term goal accomplishment should be increasingly important in determining compensation of the chief executive officer and the senior managers within corporate environment. This pattern has already begun in many of the largest firms of the Fortune 500. This trend will likely continue from the larger corporations to the very smallest companies.

"Chief executive should be the senior long-term thinker."

The allure of strategic planning, cultivated in the 1970's, is becoming more and more transparent. For most managers, it becomes clear that strategy is important but only in the sense that business survival is based upon a balance of strategy, people, financial management, information management, systems, and culture. We must focus on a balanced assessment of these elements within a company and development of a realistic work plan for the long-term.

How does a company carry out an assessment of its operations? Will that assessment translate into implemented solutions which enhance its survivability?

Most businesses can conduct an assessment for themselves. Our experience is that outsiders serve as reminders to keep the company moving.

At MRI, we use a planning tool called the business diagnostic. In a three-phased approach, we look first internally at current operations and financial position to get a "business pulse" of strengths and weaknesses. Secondly, we assess competitive strength, market attractiveness, and growth opportunities. And finally, we assist management in planning and then implementing changes to meet longer term

continued

goals. The business diagnostic is not designed to study every detail of a business nor to present an elaborate strategic plan; but rather to give senior management an objective and practical guide tailored to his/her firm's survival.

CASE STUDY

Recently, the business diagnostic was very helpful to a medium-sized firm located in a major metropolitan area with annual sales of $50 million and approximately 300 employees. This firm is a service-oriented one with a strong market niche including multiple clients. The president, also the owner, had a marketing and sales background. The company had fast growth during the 1970's, with a significant leveling of that growth through 1979 and the early 1980's.

During its rapid growth period, a sales force was carefully developed but little attention was paid to developing a strong middle management team. Much of the daily financial operations activities were directed at maintaining a cash flow and reducing dependence on both short- and long-term debt.

Profitability in the last two years was below the previous five-year period due partially to inflation and labor cost increases and partially to price sensitivity in the firm's market.

> **"Long-term goal accomplishment should be a part of setting compensation."**

An approach was developed to provide the CEO and his senior management team an assessment of their current position. The approach addressed issues such as "Where is the company now? How well is the company doing? Today, what am I in the business to do? How does my business compare with others?" Using this approach, we were able to identify with the CEO the true strengths and weaknesses of his company.

We also looked at strategic and market issues, financial and organizational issues, information issues, human resource issues, and cultural issues. However, more importantly, the CEO was able to address the issues in a nonemotional way and to prioritize immediate needs. He was able to get new insight into the current state of affairs at his company and the key problems. At the end of that phase, the CEO together with his senior managers was able to agree on the critical problems and on specific actions to correct the identified problems. Individual accountabilities were placed for completion of those high priority action items.

It became apparent that the managers of the company knew of weaknesses and strengths and knew what should be done to correct some of the weaknesses and build upon the strengths. But they had been unable to take the steps necessary to make those corrections of course. However, as the issues became de-emotionalized and prioritized, it became easier for the group to agree to an action plan.

The senior management team looked at industry trends for the future, industry association predictions, and other commonly available information to reach a consensus of what the future would hold for this company and what niche this company would have to fit in order to survive. This phase was supported by the marketing/sales force projections. All senior managers were involved in those discussions and were able to contribute to a consensus of future roles. Action steps for human resources, information resources, marketing and financial development were established. Interestingly enough, in the area of human resources, compensation packages for the senior managers were changed to reinforce the accomplishment of the longer term objectives.

The senior management team changed their attitudes from short-term goal accomplishment to one of longer-term survival. For instance, an analysis of the overhead expenditures was performed and a number of changes were made to reduce the allocation of dollars to overhead. During a growth period, larger overhead allocations were seen as a necessary part of firefighting. However, when viewed in light of survival, it became clear that alternatives did exist and overhead should absorb only the minimal dollars.

One and a half years after this project, the company is doing well and has implemented many of the original objectives. Additional longer-term strategies have been designed. The managers are much more receptive to programs based on long-term objectives.

Management in the 1980's will and must be different than the 1970's. Information and people are key resources for the future. The 1970's lulled us into believing that growth would continue forever. It is apparent that *neither growth nor survival* of a company is assured. Thus, as business managers we must take steps today toward a longer term perspective to guarantee business survival. We must move from short-range thinking to longer-term thinking, from short-term rewards to longer-term rewards. In some cases, we must reassess what the actual reward measurement should be. This is the year to take stock and to set a stronger course.

"Neither growth nor survival is assured."

"We must move from short-term thinking and rewards to longer-term planning and compensation."

MRI

Dr. Bonhag formerly managed MRI's Management Advisory Services Section. He specializes in business strategy, operations management, organizational development, and information management. He is currently on leave to serve as executive director of the Kansas City Area Health Planning Council.

Mr. WALGREN. Thank you very much, Dr. Morgan.

Let's turn to the other members of the panel and then we will have discussion.

[The biographical sketch of Mr. Stata follows:]

ANALOG
DEVICES

Ray Stata
Chairman of the Board and President

One of the founders of Analog Devices in 1965, Ray Stata has been President of the Company since 1971 and Chairman of the Board since 1973. Prior to the formation of Analog Devices, he was a founder of Solid State Instruments and became Vice President-Marketing for Kollmorgen Corporation's Inland Controls Divison when that company acquired Solid State Instruments.

Mr. Stata is active in the high technology industry and in public service. He was a founder and first President of the Massachusetts High Technology Council, where he helped devise and implement the Massachusetts Social Contract between state government and high technology industry. He is currently a member of MHTC's Executive Committee and Chairman of its Technical Education Committee.

Ray Stata is also one of 15 members of the Massachusetts Board of Regents of Higher Education and served on the Commission on Higher Education and the Economy of New England, a study group created by the New England Board of Higher Education. He holds a BSEE and MSEE from M.I.T. and serves on that institution's Visiting Committee of the Department of Electrical Engineering and Computer Science, and is on the Advisory Board of the Center for Advanced Engineering Study at M.I.T.

Received honorary Doctor of Engineering from Northeastern University, June 1981.

Also received Honorary Doctor of Business Administration from Curry College, May 1983.

Mr. STATA. Mr. Chairman, I appreciate this opportunity to tell you about the success story of the high technology industry in Massachusetts, and about how our experience may be applicable to other regions of the country.

The transition from an old turn-of-the-century industry in Massachusetts, dependent on textiles and shoes, to a new high technology industry focused on computers and electronics, occurred over a three-decade period beginning in the 1950's. The transition was, for the most part, unplanned and unforeseen. It occurred largely as a result of a high concentration of technical higher education resources. These technical resources attracted large investments of government-sponsored R&D for the cold war of the 1950's and for the space race of the 1960's, which in turn further strengthened the leadership position of the region's technical universities and in particular MIT.

To illustrate, in 1960, Massachusetts, with only 2.6 percent of the national population, produced 5.6 percent of the country's B.S. graduates in electrical engineering, 10.7 percent of the M.S. graduates, and 11.6 percent of the Ph.D.s.

By 1983, Massachusetts, with 2.7 percent of the Nation's work force, had captured 10 percent of computer-related employment, 9 percent of electronic-component employment, and 9 percent of the measurement and control-equipment employment. Massachusetts today ranks first among the 10 largest industrial States in the percentage of manufacturing in high tech—about 35 percent. Interestingly, New Hampshire, Massachusetts, Vermont, and Connecticut rank respectively first through fourth in the percentage of total employment in high tech. This illustrates the spreading effect as employment gradually permeates the regions contiguous to centers of technical higher education.

In 1965, 60 percent of the high tech employment in Massachusetts was Government-related; 15 years later, that fraction had shrunk to 25 percent, and the Massachusetts economy is now predominantly driven by commercial demand, both nationally and internationally. But the roots of this evolution can clearly be traced to Government investments in university R&D in the 1950's and 1960's. For example, 48 new commercial ventures spun off from MIT's Charles Draper Laboratories, including my own company, Analog Devices, in 1965.

One cannot overemphasize the importance of MIT in the development of the Massachusetts high technology industry. An MIT Sloan School study of 216 high tech companies in the Boston area showed that 156 of them were born in MIT departments and laboratories, including the most famous, Digital Equipment Corp., founded in 1957 by Ken Olsen.

MIT is a magnet that draws top talent from around the world. While only 9 percent of MIT's undergraduate enrollment is from Massachusetts, 36 percent of the graduates remain in the region after graduation. Today, 10,000 MIT graduates live in Massachusetts. Many of them head corporations, but equally important, many are professors and administrators in other technical universities, like Northeastern, Worcester Polytechnic, Tufts, Boston University, and the University of Massachusetts.

MIT is often referred to as a teacher of teachers. Today, MIT draws more than $100 million annually in research contracts mostly from the Federal Government, and, as a result, continues to generate an enormous number of new ideas and research-oriented graduate students.

To come back to the employment transition, between 1947 and 1979, New England's nonagricultural employment increased by 62 percent, almost 2 million jobs were added to a combined 6-state work pool of about 6 million people. The manufacturing job total, interestingly, stayed perfectly level at about 1.5 million, thus declining as a percentage of the total.

Over this 30-year span, jobs in textiles and leather shrank by 77 percent and 49 percent, respectively, while the high technology industries created an almost identical number of jobs. The strength of the economy in the late 1970's is explained by the fact that decline of employment in the older industries had subsided while employment growth in high tech continued from a higher base.

But still we must bear in mind that it was the explosive growth in service jobs and in Government jobs that accounted for nearly all the net new jobs over this period. This has led Boston University's Professor Harrison to be skeptical about the impact of high technology on overall employment patterns. In fact, he found that of the 674,000 people who left jobs in traditional New England industries, only about 18,000 were employed by high tech firms, 80,000 retired, and the rest found their way into the fast-growing service, trade, and Government sectors.

Lynn Browne, of the Boston Federal Reserve Bank, takes a more optimistic view on the impact of high tech on employment growth. In the July 1983 issue of the New England Economic Review, she suggests "that the high tech expansion has had a multiplier effect on local business services." Or, in other words, the explosive growth of the service industries could not have taken place in a vacuum. Jobs in advertising, public relations, law firms, accounting firms, data processing services, and management consultants were all closely wedded to the high tech boom.

In a broader context, today only 27 percent of jobs in Massachusetts and 20 percent of the jobs in America are in manufacturing. This percentage of jobs in manuacturing has been declining for two to three decades, and computers and factory automation will only accelerate the decline. But this is not necessarily bad, since the higher productivity of the manufacturing sector will release people and resources for the growth of the service sector. It's a replay of the first industrial revolution when mechanization increased the productivity of agriculture and released workers for employment in the industrial economy of that era.

In a 100-year period beginning around 1860, employment in agriculture dropped from 60 percent of the work force to less than 4 percent today. But this 4 percent does not include workers who manufacture farm equipment and fertilizer or meatpackers or food wholesalers and retailers. That is, many jobs today in the manufacturing and service industries are still directly tied to the agricultural industry although the nature of the jobs is quite different from agricultural jobs. By the same token, many jobs in the growing service industries are directly linked to the high technology manufacturing industry, but again the nature of the jobs is quite different.

One way to view the manufacturing sector of the high technology industry is as the toolmakers of the 1980's and 1990's. High tech products like word processors, robots, instruments and computer-aided-design and manufacturing equipment are tools which make workers in other segments of the economy more productive—workers in Government, hospitals, department stores, banks, universities, factories, workers everywhere. It is unrealistic to think that a large percentage of our work force will end up designing and manufacturing computers. But it is likely that a very large number of workers will end up using computerized equipment to improve their productivity.

Thus, the success of the high tech industry is not only important to centers like Boston where the tools are made, but also to workers elsewhere in the country where the tools are used.

For example, USM's Emhart Shoe Division in Beverly, Mass., is now producing shoes with highly-automated, computer-based equipment at prices lower than equivalent imports. By upgrading manufacturing processes, it will clearly be possible in many manufacturing industries to become internationally competitive again. From another perspective, as many as one in four employees in many computer companies are engaged in sales and service operations which are geographically dispersed from the design and manufacturing sites.

Moreover, small systems and software companies are often engaged as local consultants to apply computerized equipment at the end users' plant, and these jobs are often classified as service jobs.

In 1982, one-half of the capital equipment investments in America was for computers, communications, instruments and other electronic equipment—up from one-quarter in 1972 and one-third in 1977. Thus, the impact of high technology products on jobs and the way work is done is already very significant and growing more so each year.

So, not all growth induced by high technology will emanate from centers like Boston where very esoteric technical skills are required to design and manufacture electronic products. A much broader spectrum of the country can and will benefit as users of these products.

One impact will be revitalization of traditional industries, as I have already mentioned. Another is the emergence of new markets and industries made possible by new high techology tools.

For example, GE's Medical Division in Wisconsin has experienced substantial growth in CT scanners based on computer technology which they buy from the east and west coasts. And I would think that Detroit has just as much chance to become the robotics center of the country as Boston or Palo Alto.

Moreover, as brisk growth resumes in the high technology industry, established high tech centers like Route 128 and Silicon Valley will not be able to satisfy demand due to human-resource limitations. This will present substantial opportunities for high tech industry to develop in other parts of the country. Areas that will benefit most from this overflow will be those that already have a well-developed technical education infrastructure that presently is not being fully exploited by local industry. One such area is Chicago; another is North Carolina.

How can these incipient opportunities be nurtured and what role should the State and Federal Government play? Based on our experience in Massachusetts, I'd argue that strong partnerships between industry, academia and State government focused on exploiting the strengths and correcting the weaknesses of a given region are very powerful—not broad-based, general purpose partnerships, but highly-focused partnerships that share common issues and concern.

In 1977, a group of high tech executives formed the Massachusetts High Technology Council, because the broad-based business organizations there were not effective in providing leadership and in addressing the future needs of the State. Business, education, and Government were going off in different directions, leaving the promising high technology industry in jeopardy. A lot of good things are happening in Massachusetts today because leaders in the high tech industry took the initiative in defining policies and strategies that were conducive to the continued growth of high technology.

Industry had a role in defining future growth opportunities and identifying the resources required to get there. Industry took the lead in reaching out to local universities and in building relationships that will help them solve their problems while acquainting the universities with their own problems and needs. We are seeing very promising programs in Massachusetts as a result of these budding relationships.

State government had an important role to play in reorienting the goals and resources of education at all levels to be more responsive to the needs of emerging growth industries as well as the needs of displaced workers. In Massachusetts, state government had a special challenge to bring the tax burden on individuals more in line with other States—a challenge which has been met in only 5 years.

The Federal Government has two essential roles to play to facilitate the transition, which is now underway, to a more productive, knowledge-intensive economy. One is to manage the cost of capital and its allocation between consumption and investment so as to encourage the modernization of our manufacturing industry and the investment in new tools to make our workers more productive. Presently, the high cost of capital is substantially inhibiting these investments.

Equally important, the Federal Government in this country has assumed a dominant role for investments in basic research and the subsidizing of graduate education in many technical fields. About two-thirds of the $7 billion investment in university research comes from the Federal Government. This investment has served America well in generating new knowledge that has kept us ahead in technical innovation. It has also served us well in educating and training doctoral graduates that are required to expand and renew our university teaching and research facilites.

Today, the largest threat to growth of the high technology industry in Massachusetts, and in the rest of America as well, is a shortage of engineers. This stems not from a lack of qualified and interested high school graduates, but from a lack of university faculty to teach them.

Nothing is more important to the future of the high technology industry in America than strengthening our graduate level research and education programs in our major research universities, both through tax credits for industry contributions to universities and through grants to encourage and support close working relationships that are beginning to develop between industry and academia.

Thank you.

[The prepared statement of Mr. Stata follows:]

TESTIMONY

RAY STATA

WASHINGTON, D.C.

JUNE 16, 1983

THE IMPACT OF HIGH TECHNOLOGY INDUSTRIES ON MASSACHUSETTS AND THE NEW ENGLAND REGION

INTRODUCTION

NEW ENGLAND'S ECONOMIC METAMORPHOSIS FROM OLD TURN-OF-THE-CENTURY INDUSTRY TO THE NEW HIGH TECHNOLOGIES IS A TRULY UNIQUE STORY. IT IS ONE OF THE RARE CASES WORLD-WIDE OF A RELATIVELY SMOOTH AND RAPID REGIONAL ADAPTATION TO NEW ECONOMIC OPPORTUNITIES. MASSACHUSETTS, WITH WHICH I AM MOST FAMILIAR, IS AT THE CORE OF THIS TRANSITION. BUT THE IMPACT OF ITS NEW ECONOMIC FOUNDATION OF KNOWLEDGE-INTENSIVE EMPLOYMENT HAS GROWN TO AFFECT THE ECONOMIC FUTURES OF A NUMBER OF ITS NEIGHBORING NEW ENGLAND STATES AS WELL. NOT ONLY DOES MASSACHUSETTS RANK HIGHEST IN HIGH TECHNOLOGY EMPLOYMENT RELATIVE TO THE REST OF THE NATION, BUT SO DO NEIGHBORING STATES IN NEW ENGLAND.

STATE HIGH TECH EMPLOYMENT AS A % OF TOTAL (Nat'l Ranking)

STATE (Sampling)	PERCENT	RANK
NEW HAMPSHIRE	10.4	1
MASSACHUSETTS	9.3	2
VERMONT	8.7	3
CONNECTICUT	7.1	4
NEW JERSEY	6.1	7
CALIFORNIA	6.07	8
NEW YORK	5.3	9
TEXAS	3.1	17

THIS TRANSITION FROM OLD TO NEW, WHICH OCCURRED OVER A THREE DECADE PERIOD SPANNING THE LATE 1950s, AND THE 1960s AND 1970s, IS PARTIALLY EXPLAINED BY A NUMBER OF DELIBERATE DECISIONS BUT ALSO BY A NUMBER OF FORTUITOUS CIRCUMSTANCES THAT WOULD PROVIDE THE REGION AND THE STATE WITH A UNIQUE COMPETITIVE ADVANTAGE OVER OTHER PARTS OF THE NATION. SOME OF THE DOMINANT FACTORS ARE EXPLAINED LATER IN THIS DOCUMENT. OF THESE, IT WAS THE VERY HIGH CONCENTRATION OF HIGHER EDUCATION INSTITUTIONS AND A LONG TRADITION OF HIGH STANDARDS OF EDUCATION THAT PROVED A FUNDAMENTAL CATALYST IN THE REGION'S UNPARALLELED TRANSITION FROM SHOES AND TEXTILES TO CHIPS AND COMPUTERS AS ECONOMIC MAINSTAYS.

WHAT IS EXPLAINED IN THE FOLLOWING PAGES IS (1) THE STATISTICAL DESCRIPTION OF THIS TWO DECADE LONG TRANSITION, (2) SOME OF THE DELIBERATE EFFORTS GROUPS SUCH AS THE FIVE-YEAR OLD MASSACHUSETTS HIGH TECHNOLOGY COUNCIL HAS TAKEN TO STIMULATE THE CHANGE, AND (3) THE ROAD AHEAD THAT REQUIRES EVEN GREATER NUTURING FOR IT TO REMAIN AS FULL OF GROWTH OPPORTUNITY AS THE LAST TWO DECADES. IN PART, THE COMMENTS THAT FOLLOW TRY TO EXPLAIN THE IMPACT OF HIGH TECHNOLOGY ON THE EMPLOYMENT AND FUTURE ECONOMIC OPPORTUNITIES OF MASSACHUSETTS AND THE REGION TO WHICH IT IS THE VITAL CORE. ALSO SOME SUGGESTIONS ARE MADE AS TO HOW NEW ENGLAND'S EXPERIENCE MAY AND MAY NOT BE APPLICABLE TO OTHER PARTS OF THE COUNTRY.

WHAT HAPPENED?

UNTIL 1983, MASSACHUSETTS WEATHERED THE NATIONAL AND GLOBAL RECESSION WITH BELOW AVERAGE UNEMPLOYMENT RATES AND A LONG LIST OF RAPID GROWTH STORIES IN HIGH-TECHNOLOGY ELECTRONICS AND COMPUTER FIRMS. DURING THE LAST FIVE YEARS OF THE 1970s, ITS TOTAL PRIVATE SECTOR EMPLOYMENT BASE GREW FROM 1,875,000 JOBS TO 2,165,000. THE LEADERS IN THIS 290,000 INCREASE WERE THE SERVICE SECTOR (117,000 NEW JOBS) AND MANUFACTURING SECTOR (94,000 NEW JOBS). OF THE LATTER, ALMOST 31 PER CENT OF THE JOBS ARE IN TWO SIC CODES (35 & 36) WHICH INCLUDE ELECTRONICS AND COMPUTERS. AMONG THE TEN LARGEST INDUSTRIAL STATES, MASSACHUSETTS IS RANKED FIRST IN THE PROPORTION OF PEOPLE IN HIGH TECHNOLOGY-RELATED EMPLOYMENT.

	% OF MANUFACTURING IN HI-TECH EMPLOYMENT:		
TEN LARGEST INDUSTRIAL STATES	1980	RANK	#(000s)
MASSACHUSETTS	34.8	1	235.0
CALIFORNIA	29.9	2	601.2
NEW YORK	25.7	3	374.5
NEW JERSEY	23.7	4	184.8
FLORIDA	23.6	5	107.1
ILLINOIS	19.1	6	237.0
PENNSYLVANIA	16.0	7	213.8
TEXAS	15.0	8	157.8
OHIO	12.0	9	151.4
MICHIGAN	8.2	10	80.9

Source: Massachusetts Division of Employment Security (July 1982)

OF THE 235,000 JOBS IN HIGH TECHNOLOGY INDUSTRIES, TYPICALLY ONE-THIRD ARE PROFESSIONALS WITH COLLEGE DEGREES OF WHICH MORE THAN ONE-HALF ARE TECHNICAL DEGREES; ONE-THIRD ARE PARA-PROFESSIONALS REQUIRING TWO OR MORE YEARS OF EDUCATION BEYOND HIGH SCHOOL; AND ONE-THIRD ARE UNSKILLED OR LOWER SKILLED WORKERS.

THE MASSACHUSETTS HIGH TECHNOLOGY COUNCIL (MHTC), WITH A MEMBERSHIP OF 137 FIRMS AND EMPLOYMENT OF 128,000, REPRESENTS ABOUT ONE-HALF THE STATE'S HIGH TECHNOLOGY EMPLOYMENT. A SURVEY OF MHTC MEMBERS CONDUCTED IN 1982 IN THE MIDST OF THE RECESSION, SHOWED THAT THESE COMPANIES EXPECT TO CREATE 50,000 NEW JOBS IN MASSACHUSETTS BY 1985 - A CONTINUED GROWTH RATE OF 13%.

SUCH NUMBERS PROVIDE A PICTURE OF A HEALTHY STATE ECONOMY WHICH HAS MANAGED TO BUILD A STRONG BASE IN THE HIGH TECHNOLOGY MANUFACTURING SECTORS. THE STATE WHICH IN 1983 HAS ONLY 2.75% OF THE TOTAL EMPLOYED WORK FORCE IN THE UNITED STATES, HAS 10% OF THE COMPUTER RELATED EMPLOYMENT, 9% OF THE COMPONENTS EMPLOYMENT, 9% OF THE MEASURING AND CONTROL EQUIPMENT EMPLOYMENT. SUCH RATIOS RANK MASSACHUSETTS FIRST AMONG THE LEADING INDUSTRIAL STATES AS A HIGH TECHNOLOGY EMPLOYER.

FOR NEW ENGLAND, AND MASSACHUSETTS IN PARTICULAR, THE TRANSITION FROM OLD TO NEW OCCURRED WITH STARTLING RAPIDITY. THE EMPLOYMENT EFFECTS WERE NEITHER FORECAST NOR ANTICIPATED. FROM 1947 THROUGH 1979, NEW ENGLAND'S NON-AGRICULTURAL EMPLOYMENT INCREASED BY 62%; ALMOST TWO MILLION NEW JOBS WERE ADDED TO A COMBINED SIX-STATE WORK POOL OF ABOUT 6 MILLION PEOPLE. THE MANUFACTURING JOB TOTAL, INTERESTINGLY, STAYED PERFECTLY LEVEL AT ABOUT 1.5 MILLION. BUT A BREAKDOWN OF THIS NUMBER SHOWS THAT TWO OF THE REGIONS STRONGEST "OLD" INDUSTRIES, TEXTILES AND LEATHER, SHRANK BY 77% AND 49% RESPECTIVELY. FOR A LOSS OF 275,000 JOBS. ALMOST THAT SAME NUMBER OF NEW JOBS WAS ACCOUNTED FOR BY THREE CATEGORIES OF DURABLE GOODS MANUFACTURERS: ELECTRICAL MACHINERY, TRANSPORTATION EQUIPMENT, AND INSTRUMENTS. THIS TRANSITION TO HIGH TECHNOLOGY EMPLOYMENT CUSHIONED THE IMPACT OF THE STRUCTURAL ECONOMIC CHANGE AFFECTING THE REGIONAL MANUFACTURING ECONOMY OF NEW ENGLAND. THE REGION IS NOW POISED FOR A PERIOD OF RAPID GROWTH AS HIGH TECHNOLOGY HAS BECOME A SIGNIFICANT EMPLOYMENT FACTOR AND AS THE DECLINE OF OLDER INDUSTRIES HAS SUBSIDED. IN THE LATTER CASE MORE AND MORE EVIDENCE IS GATHERING THAT IN SOME OLD INDUSTRIES SUCH AS SHOES AND MACHINE TOOLS, THE ADAPTATION OF ELECTRONIC TECHNOLOGIES IS CREATING A WHOLE NEW GENERATION OF WORLD COMPETITIVE COMPANIES.

IN BEVERLY, MASSACHUSETTS, FOR EXAMPLE, THE USM-EMHART SHOE DIVISION IS NOW PRODUCING SHOES WITH HIGHLY AUTOMATED COMPUTER BASED EQUIPMENT AT PRICES LOWER THAN THOSE COMING FROM CHEAP LABOR REGIONS IN OTHER PARTS OF THE WORLD.

THE QUALITATIVE FEATURES OF THIS STRUCTURAL SHIFT ARE USEFUL GUIDES TO OTHER REGIONS CURRENTLY FACED WITH SIMILAR STRUCTURAL UNEMPLOYMENT. MOST IMPORTANT IS THE OBSERVATION THAT HIGH TECHNOLOGY INDUSTRIES WERE NOT ABLE TO DIRECTLY ABSORB 'OLD INDUSTRY' LABOR. BETWEEN 1958 AND 1975, 674,000 PEOPLE LOST JOBS IN TRADITIONAL NEW ENGLAND INDUSTRIES OUT OF A STARTING POOL OF 833,000. OF THOSE DISPLACED, ONLY 18,000 WERE ESTIMATED BY BOSTON UNIVERSITY PROFESSOR BENNETT HARRISON TO BE EMPLOYED BY HIGH TECHNOLOGY FIRMS: EIGHTY THOUSAND HAD RETIRED; THE REST FOUND THEIR WAY INTO SERVICE, TRADE, OR GOVERNMENT JOBS. HARRISON, WHO IS SKEPTICAL ABOUT THE IMPACT OF HIGH TECHNOLOGY ON OVERALL EMPLOYMENT PATTERNS, REFLECTS AN INCREASING CONCERN THAT TOO MUCH ECONOMIC MAGIC IS ATTRIBUTED TO HIGH-TECHNOLOGY. HE ATTEMPTS IN HIS STUDIES TO TAKE THE NARROWEST VIEW OF THE RELATIONSHIP BETWEEN HIGH TECHNOLOGY GROWTH AND THE RAPID EVOLUTION OF SERVICE SECTOR EMPLOYMENT.

HOWEVER, THE IMMENSE PARALLEL GROWTH THAT OCCURRED IN THE NON-MANUFACTURING SECTORS DID NOT HAPPEN IN A VACUUM OF OTHER

FORCES. IT IS QUESTIONABLE WHETHER SUCH RATES OF GROWTH COULD HAVE BEEN ACHIEVED IN THE ABSENCE OF A VIBRANT HIGH TECHNOLOGY INDUSTRY. TWO MILLION NEW JOBS WERE CREATED. IN NEW ENGLAND TRADE EMPLOYMENT ALMOST DOUBLED TO REACH 1,150,000; SERVICES, GOVERNMENT, FINANCE, INSURANCE AND REAL ESTATE ROSE 275% TO 2,287,000. A STRUCTURAL SHIFT HAD OCCURRED - FOLLOWING PATTERNS COMMON TO THE NATION.

VIEWED FROM A STATE PERSPECTIVE, THE NEW SERVICE JOBS HAVE TRULY EXPLODED TO ABOUT 1.5 MILLION. IN MASSACHUSETTS RETAIL TRADE IS NOW THE SINGLE LARGEST SERVICE EMPLOYMENT CATEGORY WITH 442,150 WORKERS IN 1980, or 17% OF ALL PEOPLE EMPLOYED. HEALTH SERVICES EMPLOY 230,000 AND EDUCATION AN EQUAL AMOUNT OR ABOUT 7% EACH. HIGH TECHNOLOGY EMPLOYMENT IN MASSACHUSETTS, AS PREVIOUSLY MENTIONED, TOTALS 235,000 - AN AMOUNT ABOUT EQUIVALENT TO HEALTH SERVICE AND EDUCATION. THE STRENGTH OF THESE SECTORS HELPED THE STATE RIDE THROUGH THE RECESSION WITH UNEMPLOYMENT RATES AT 7.8% IN 1982 -- MORE THAN 2 POINTS LOWER THAN THE NATIONAL RATE. IN 1976, COMPUTER MANUFACTURERS EMPLOYED HALF AS MANY PEOPLE, COMMUNICATIONS AND ELECTRONIC COMPONENTS THIRTY PER CENT LESS THAN IN 1982.

IN A REPORT RELEASED BY THE FEDERAL RESERVE BANK IN THE JULY/AUGUST ISSUE OF NEW ENGLAND ECONOMIC REVIEW (1983) LYNN BROWNE SUGGESTS THAT "THE HIGH TECH EXPANSION HAS HAD A MULTIPLIER EFFECT ON LOCAL BUSINESS SERVICES." IN ADVERTISING, FOR EXAMPLE, SHE REPORTS A 30 TO 40 PER CENT EMPLOYMENT INCREASE ATTRIBUTED TO HIGH TECH COMPANY EXPENDITURES BETWEEN 1975 AND 1980. RAPID GROWTH IS EVIDENT, ALSO, IN COMPUTER AND DATA PROCESSING SERVICES AND MANAGEMENT CONSULTING SERVICES. BOTH, SHE ARGUES, ARE CLOSELY WEDDED TO THE GROWTH PATH OF THE ELECTRONICS AND COMPUTER INDUSTRY. HER ANALYSIS REPORTS ALMOST A ONE-TO-ONE RATIO BETWEEN JOBS CREATED IN OFFICE AND COMPUTING MACHINE SECTORS AND THOSE IN COMPUTER SERVICES. IN ADDITION, ONE FINDS A "MANAGEMENT, CONSULTING, AND PUBLIC RELATIONS INDUSTRY THAT IS ABOUT THE SAME SIZE AS COMPUTER AND DATA PROCESSING SERVICES."

IN OTHER WORDS THE LEVERAGE OF MANUFACTURING JOBS IN THE REGION'S AND IN THE NATION'S ECONOMY MAY BE HIGHER THAN COMMONLY PRESUMED. ONLY 27% JOBS IN MASSACHUSETTS AND 20% IN THE UNITED STATES ARE IN MANUFACTURING. BUT WITHOUT THESE PRIMARY JOBS OTHER SUPPORTING AND DEPENDENT JOBS COULD NOT BE SUSTAINED. FURTHERMORE, MANUFACTURING JOBS AS A PERCENTAGE OF TOTAL EMPLOYMENT HAS BEEN IN DECLINE FOR TWO TO THREE DECADES AND THIS

TREND WILL ONLY ACCELERATE AS COMPUTERS AND AUTOMATION INCREASE THE PRODUCTIVITY OF MANUFACTURING WORKERS. BUT THIS IS NOT NECESSARILY BAD, SINCE THE LOWER COST OF MANUFACTURED GOODS AND THE RESOURCES CREATED BY HIGHER PRODUCTIVITY CAN BE RELEASED FOR THE GROWTH OF SERVICE INDUSTRIES. THUS WE ARE FOLLOWING A PATTERN SIMILAR TO THE FIRST INDUSTRIAL REVOLUTION WHEN HIGHER AGRICULTURAL PRODUCTIVITY RELEASED WORKERS FOR THE GROWTH OF THE INDUSTRIAL WORKFORCE.

EMPLOYMENT BY INDUSTRY - 1982
(000's)

	UNITED STATES			MASSACHUSETTS		
	NO.		%	NO.		%
Non-Mfg.	73,447		74.7	1,876		72.2
Services		20.4			23.4	
Govt.		16.0			13.6	
Retail/Wholesale Trade		20.9			19.0	
Other*		17.4			16.2	
Mfg.	20,133		20.5	702		27.0
Agr.	4,750		4.8	20		.8
TOTALS	98,330		100	2,598		100

*Finance, Real Estate, Construction, Utilities and Transportation

THE LEGACY OF A SHIFTING EMPLOYMENT STRUCTURE IS A VERY BULLISH KNOWLEDGE-INTENSIVE INDUSTRY IN THE REGION. NOT ONLY HAS IT ACTED AS A CATALYST AND STIMULANT TO THE SIX NEW ENGLAND STATES BUT TO A LARGE NATIONAL ECONOMY. THIS DOES NOT MEAN THAT POCKETS OF DIFFICULTY DO NOT ADAPT EASILY. OLD TEXTILE TOWNS SUCH AS FALL RIVER STILL DO NOT ENJOY THE ECONOMIC VITALITY GENERALLY FELT IN MANY OTHER PARTS OF THE STATE. OTHER TOWNS SUCH AS LOWELL, MASSACHUSETTS, EXPERIENCED LENGTHY PERIODS OF POVERTY AND HIGH EMPLOYMENT DISLOCATION. IN LOWELL'S CASE AN ENORMOUS REVITALIZATION IS OCCURING LARGELY AS A RESULT OF THE RECENT EXPANSION OF WANG LABORATORIES IN THAT CITY. WORCESTER IS NOW IN THE PROCESS OF EXPERIENCING AN ECONOMIC REBIRTH AFTER MANY UNCERTAIN YEARS IN NOT KNOWING WHAT DIRECTION ITS ECONOMIC FUTURE WOULD TAKE. HERE TOO, HIGH TECHNOLOGY ABSORBED INTO OLD FIRMS OR WITHIN NEW ONES, IS THE PRIMARY FORCE IN GIVING NEW LIFE TO THE LOCAL ECONOMY.

AS THE NEXT ROUND OF GROWTH OCCURS IN THE STATE, IT IS EXPECTED THAT OTHER PARTS OF THE STATE WILL BENEFIT FROM EXPANSION AS HIGH TECH COMPANIES LOOK FOR UNTAPPED LABOR MARKETS CLOSE TO THEIR CURRENT CENTERS OF ACTIVITY. DIGITAL EQUIPMENT CORPORATION HAS PURCHASED OPEN ACREAGE IN PLYMOUTH NEAR CAPE COD IN

ANTICIPATION OF EXPANSION; AND WANG LABORATORIES IS BUYING PROPERTY IN THE CONNECTICUT VALLEY AREA AROUND HOLYOKE WITH SIMILAR EXPECTATIONS OF EXPANSION IN THE STATE.

WHAT EXPLAINS THIS TRANSITION

A VARIETY OF FACTORS - MANY OF THEM FORTUITOUS - CONVERGED TO MAKE MASSACHUSETTS (AND NEW ENGLAND) PARTICULARLY WELL SUITED TO THE RAPID GROWTH OF HIGH TECHNOLOGY INDUSTRIES.

TWO CHARACTERISTICS ARE OF PARTICULAR IMPORTANCE IN EXPLAINING THE SUCCESS EXPERIENCED BY THE STATE. A LONG HISTORY OF PRIVATE AND PUBLIC HIGHER EDUCATION IS ONE; A HEAVY CONCENTRATION OF FEDERAL FUNDS INTO DEFENSE AND SPACE RELATED RESEARCH DURING THE POST-WAY YEARS IS A SECOND (A FACTOR GREATLY INFLUENCED BY THE PRESENCE OF MIT).

NEW ENGLAND HAS LONG BEEN KNOWN FOR ITS EDUCATIONAL RESOURCES IN HIGHER EDUCATION. TWO HUNDRED AND SIXTY COLLEGES AND UNIVERSITIES ARE CONCENTRATED IN THE SIX CONTIGUOUS STATES. THE LARGEST - AND MOST SCIENTIFICALLY ORIENTED - ARE IN MASSACHUSETTS. IN 1960-61, THE STATE WITH ONLY 2.6% OF THE NATIONAL POPULATION PRODUCED 4.2% OF ALL THE BACHELORS GRADUATED THAT YEAR IN ALL DISCIPLINES, 6.3% OF ALL MASTERS, AND 7.4% OF ALL

DOCTORATES. TWENTY YEARS LATER, MASSACHUSETTS STILL RETAINED A LEAD DESPITE RAPID EXPANSION OF HIGHER EDUCATION INSTITUTIONS NATION-WIDE. IN ALL DISCIPLINES, THE RATIOS HELD AT 4%, 4.5% AND 6%.

IN SCIENCES AND ENGINEERING, AT THE BEGINNING OF THIS PERIOD MASSACHUSETTS SHOWED AN EVEN GREATER ADVANTAGE. IN SOME FIELDS, SUCH AS ELECTRICAL ENGINEERING, 5.6% OF THE BS GRADUATES CAME FROM THE STATE, 10.7% OF THE MS's, AND 11.6% OF THE PH.D.'s. BY THE LATE 1970s THIS NUMERICAL ADVANTAGE HAD ABATED SOMEWHAT BUT STILL REMAINED FAR ABOVE THE NATIONAL AVERAGE. OF 63,000 ENGINEERS RECEIVING BACHELORS DEGREES NATION WIDE IN 1982, 5,000 CAME FROM NEW ENGLAND; 3,000 WERE GRADUATED IN MASSACHUSETTS. THE IMPORTANCE OF ELECTRICAL ENGINEERING TO THE INDUSTRY IS DEMONSTRATED BY THE FACT THAT ONE OF TWO EMPLOYED TECHNICAL PROFESSIONALS IN THE INDUSTRY IS EITHER AN ELECTRICAL ENGINEER OR A COMPUTER SCIENTIST.

THE VALUE OF THIS INTELLECTUAL RESOURCE TO THE STATE AND THE REGION IS IMMENSE. LYNN BROWNE, ECONOMIST AND VICE PRESIDENT OF THE FEDERAL RESERVE BANK OF BOSTON, WRITES THAT "ALMOST ALL SCIENTISTS AND ENGINEERS LIVING IN NEW ENGLAND RECEIVED THEIR LAST

SCHOOLING THERE; CONVERSELY VERY FEW OF THOSE LIVING IN THE REGION WERE LAST EDUCATED SOMEWHERE ELSE. SUCH A PATTERN STRONGLY SUGGESTS THAT NEW ENGLAND INSTITUTIONS OF HIGHER EDUCATION PLAY A VITAL ROLE IN ATTRACTING AND RETAINING PROFESSIONAL MANPOWER." OTHER STUDIES SHOW THAT 94% OF THE ENGINEERS AND SCIENTISTS WORKING IN MASSACHUSETTS RECEIVED THEIR LAST FORMAL EDUCATION LOCALLY.

LEADERSHIP OF KEY UNIVERSITIES IS A MAJOR FACTOR IN EXPLAINING THE MASSACHUSETTS TECHNOLOGICAL EVOLUTION. THIS WAS ILLUSTRATED BY JOHN DONOVAN OF MIT's SLOAN SCHOOL OF MANAGEMENT. HE STUDIED 216 HIGH TECHNOLOGY COMPANIES IN THE GREATER BOSTON AGGLOMERATION AND FOUND THAT 156 OF THESE WERE BORN IN MIT DEPARTMENTS OR LABORATORIES. THE MOST FAMOUS START-UP TO COME OUT OF MIT IS THE DIGITAL EQUIPMENT CORPORATION FOUNDED IN 1957 BY KENNETH OLSEN. THIRTY-EIGHT OF THE MHTC's MEMBER COMPANIES ARE RUN BY MIT GRADUATES. THE INSTITUTE IS NET IMPORTER OF STUDENTS TO THE REGION. NINETY PER CENT OF ITS STUDENTS ARE FROM OUT-OF-STATE; YET THIRTY-SIX PERCENT REMAIN IN THE REGION AFTER GRADUATION. TODAY 10,000 OF ITS GRADUATES LIVE IN MASSACHUSETTS. MANY OF THESE NOT ONLY ARE CORPORATE EMPLOYEES BUT A SIGNIFICANT NUMBER BECOME KEY FACULTY RESOURCES IN A VARIETY OF INSTITUTIONS SUCH AS NORTHEASTERN UNIVERSITY, WORCESTER POLYTECHNIC, TUFTS

UNIVERSITY, BOSTON UNIVERSITY, UNIVERSITY OF MASSACHUSETTS, UNIVERSITY OF LOWELL, AND OTHERS. A PROBLEM LOOMING FOR THE REGION, HOWEVER, IS THAT MIT HAS CAPPED FURTHER GROWTH, AS HAS MANY OTHER PRESTIGIOUS PRIVATE UNIVERSITIES. CLEARLY THIS WILL IN TIME DIMINISH THE BENEFICIAL IMPACT OF THIS IMPORTANT TECHNICAL UNIVERSITY IN THE REGION.

THE NEW ENGLAND BOARD OF HIGHER EDUCATION NOTED IN A MARCH 1982 REPORT THAT THE REGION, WITH 800,000 STUDENTS IN COLLEGES AND UNIVERSITIES, "IS UNQUESTIONABLY THE MOST KNOWLEDGE-INTENSIVE REGION IN THE WORLD. THIS KNOWLEDGE-INTENSITY MAY BE A KEY - IF NOT THE KEY - TO THE FUTURE PROSPERITY OF NEW ENGLAND."

A SECOND IMPORTANT FACTOR EXPLAINING THE RAPID GROWTH OF HIGH TECHNOLOGY INDUSTRIES IN MASSACHUSETTS WAS A HIGH INVESTMENT BY BOTH THE DEPARTMENT OF DEFENSE AND NASA IN RESEARCH FACILITIES BASED IN THE STATE - EDUCATIONAL, CORPORATE AS WELL AS GOVERNMENT LABORATORIES LIKE LINCOLN LABS, MITRE CORPORATION AND DRAPER LABS. DURING THE LATE 1950s ALMOST HALF OF THE HIGH TECHNOLOGY EMPLOYMENT WAS DEFENSE OR NASA DEPENDENT. BY 1965 THE PROPORTION ROSE TO ABOUT 60%. WHILE THIS HIGH DEPENDENCE ON FEDERAL SUPPORT HELPED NURTURE THE GROWTH OF THE INDUSTRY AND AN

INFRASTRUTURE OF LABORATORIES AND SUPPLIERS, THE EFFECTS WOULD BE BOTH POSITIVE AND NEGATIVE IN THE YEARS AHEAD. ONE OF THE MOST POSITIVE EFFECTS WAS THAT NUMEROUS SPIN-OFF COMPANIES WERE BORN OUT OF FEDERAL-RELATED RESEARCH CONTRACTS. THE MIT-LINKED CHARLES DRAPER LABORATORIES (NOW INDEPENDENT OF THE INSTITUTE), A RECIPIENT OF VERY LARGE DEFENSE CONTRACTS, ENGAGED IN PROJECTS THAT SPUN-OFF 48 NEW COMMERCIAL VENTURES. MY COMPANY, ANALOG DEVICES, IS ONE OF THEM. WE ARE NOW A $200 MILLION CORPORATION WITH THE BULK OF OUR SALES COMING FROM NON-DEFENSE CLIENTS WORLDWIDE.

THE NEGATIVE EFFECTS OF THIS HIGH ECONOMIC DEPENDENCE ON DEFENSE AND NASA RESEARCH FUNDS WERE FELT WHEN MANY PROJECTS WERE TERMINATED AS THE GOVERNMENT SHARPLY CURTAILED MILITARY AND SPACE PROGRAMS IN THE EARLY 70's. THIS CAUSED IMMENSE DISLOCATION IN THE GROWTH OF HIGH TECHNOLOGY INDUSTRIES LOCALLY. DURING THE EARLY 1970s MANY SUB-SECTORS OF THE INDUSTRY EXPERIENCED FLAT GROWTH OR EVEN DECLINES. IN MASSACHUSETTS, OF TWENTY SIC SECTORS DEFINING THE HIGH TECHNOLOGY INDUSTRY ONLY THREE SHOWED SIGNIFICANT GROWTH: COMPUTERS, TRANSPORTATION EQUIPMENT AND PHOTOGRAPHIC EQUIPMENT. THE STATE'S ECONOMY EXPERIENCED UNEVEN FLOWS OF FEDERAL SUPPORT DURING THE 70s INCLUDING A SEVERE DOWNTURN IN THE BEGINNING OF THE DECADE.

BY THE EARLY 1980s DEFENSE EXPENDITURES STILL PLAYED A VERY IMPORTANT ROLE IN MASSACHUSETTS. THE STATE IS THE EIGHTH LARGEST RECIPIENT OF DEFENSE RELATED DOLLARS IN THE NATION. MIT IS A RECIPIENT OF MORE THAN $100 MILLION RESEARCH CONTRACTS ANNUALLY. BUT DRAPER LABORATORIES, MITRE COPORATION, LINCOLN LABS, RAYTHEON AND OTHER LARGE CONTRACTORS NOW ACCOUNT FOR ONLY TWENTY-FIVE PERCENT OF THE HIGH TECHNOLOGY MANUFACTURING EMPLOYMENT IN THE STATE. IT IS QUITE APPARENT THAT MASSACHUSETT's HIGH TECHNOLOGY ECONOMY IS NOW DRIVEN BY DEMAND FROM COMMERCIAL CLIENTS BOTH NATIONALLY AND INTERNATIONALLY. THAT DEMAND SHOWS NO SIGNS OF ABATING DURING THE COMING DECADE OR MORE, ASIDE FROM THE CURRENT RECESSIONARY SLUMP THAT FINALLY CAUGHT UP WITH MASSACHUSETTS IN THE LAST TWELVE MONTHS.

BOTTLENECKS TO GROWTH

BY THE LATE SEVENTIES, THE HIGH TECH INDUSTRY IN MASSACHUSETTS WAS BOOMING. GROWTH RATES AT COMPANIES LIKE DIGITAL EQUIPMENT CORPORATION, DATA GENERAL AND WANG LABORATORIES WERE OFTEN MEASURED AT A RATE OF 40-45% A YEAR AND SUCH RATES OF GROWTH WERE COMMON TO MANY OTHER FIRMS, TOO. CONSEQUENTLY THE STATE LITERALLY BEGAN TO RUN OUT OF QUALIFIED PEOPLE - NOT ONLY ENGINEERS BUT TECHNICIANS AND COMPUTER PROGRAMMERS. THE PROBLEM BECAME ESPECIALLY ACUTE FOR ELECTRICAL ENGINEERS AND TECHNICAL MANAGERS.

WHILE THIS PROBLEM PLAGUED A NUMBER OF HIGH TECHNOLOGY REGIONS THROUGHOUT THE NATION, IT WAS EXACERBATED IN MASSACHUSETTS BY (1) THE IMAGE OF THE STATE AS "TAXACHUSETTS" WITH INORDINANTLY HIGH TAX RATES, AND (2) LACK OF RESPONSIVENESS OF MANY SCHOOLS TO THE PRESSING NEEDS OF THE HIGH TECHNOLOGY INDUSTRY. RECRUITING SKILLED PEOPLE TO COME TO MASSACHUSETTS BECAME MORE AND MORE DIFFICULT BECAUSE OF ITS TAX IMAGE AND BECAUSE OF A RISING TIDE OF MEDIA ARTICLES THAT DISCOUNTED MASSACHUSETTS AS A PLACE WITH A HIGH TECH FUTURE - WHILE OFFERING SILICON VALLEY AS THE PLACE WHERE THE FUTURE WAS HAPPENING.

AWARE OF THE LONG-TERM DAMAGE THESE CONDITIONS MIGHT IMPOSE ON THE STATE, A GROUP OF HIGH TECHNOLOGY EXECUTIVES FORMED THE MASSACHUSETTS HIGH TECHNOLOGY COUNCIL IN 1977. THE PURPOSE WAS TO AFFECT CHANGE IN A NUMBER OF WAYS:

(a) IN AN UNUSUAL POSTURE FOR BUSINESS, THE PERSONAL INCOME TAX RATE WAS TARGETED FOR REFORM IN ORDER TO MAKE MASSACHUSETTS A MORE ATTRACTIVE PLACE TO LIVE AND WORK, ESPECIALLY FOR TECHNICAL PROFESSIONALS IN SHORT SUPPLY.

(b) HIGHER EDUCATION, VIEWED AS UNRESPONSIVE TO SURGING DEMAND BY HIGH TECH COMPANIES, WOULD HAVE TO PRODUCE MORE COMPUTER SCIENTISTS, PROGRAMMERS, ENGINEERS AND TECHNICIANS.

TO ACHIEVE THESE GOALS, A NUMBER OF PARALLEL EFFORTS WERE UNDERTAKEN BY THE MHTC.

1. THE STATE TAX BURDEN, BETWEEN 1970 AND 1977, HAD GROWN TWICE AS FAST IN 17 OTHER INDUSTRIAL STATES - TO A LEVEL 20% HIGHER THAN THE AVERAGE RATE IN THOSE STATES. STATE PERSONAL INCOME TAXES RANKED MASSACHUSETTS 8th HIGHEST IN THE NATION. LOCAL PROPERTY TAXES WERE 2nd HIGHEST.

CONCERN ABOUT THIS NEGATIVE TREND ON THE STATE'S FUTURE COMPETITIVENESS, MHTC DEVELOPED A UNIQUE CONTRACT BETWEEN THE HIGH TECHNOLOGY INDUSTRY AND GOVERNMENT. A SOCIAL CONTRACT WAS AGREED TO IN FEBRUARY 1979 CALLING FOR INDUSTRY TO CREATE 60,000 NEW JOBS IN RETURN FOR A COMPETITIVE TAX POLICY. THIS APPROACH WORKED. NOT ONLY WERE THE JOBS CREATED BUT BY 1982 TAX BURDEN AS A PERCENTAGE OF PERSONAL INCOME HAD DROPPED BELOW THE NATIONAL AVERAGE, SPURRED IN PART BY A STATE-WIDE REFERENDUM CAMPAIGN MOUNTED BY MHTC TO CAP PROPERTY TAX RATES AT 2 1/2% OF MARKET RATES - WIDELY KNOWN AS PROPOSITION 2 1/2.

2. A MISMATCH BETWEEN SUPPLY AND DEMAND OF SKILLED MANPOWER WAS GIVEN WIDE PUBLIC VISIBILITY BY SURVEYING MEMBER FIRMS OF MHTC AND PUBLICIZING THE RESULTS. FOR THE FIRST TIME IN THE STATE, BOTH EDUCATORS AND POLICYMAKERS WERE FACED WITH A CONCRETE SET OF NUMBERS BY JOB CATEGORY. AT THE SAME TIME INFORMATION WAS PRESENTED TO INDICATE WHAT WAS IN THE EDUCATIONAL PIPELINE, ESPECIALLY IN OUR ENGINEERING SCHOOLS. THE GAP BETWEEN SUPPLY AND DEMAND WAS EVIDENT WHICH LAUNCHED A PUBLIC DIALOGUE ON STATE EDUCATIONAL PRIORITIES AND NEEDS. THIS DIALOGUE WAS SOON PICKED UP BY THE AMERICAN ELECTRONICS ASSOCIATION AND EXTENED WITH EQUAL SUCCESS ON A NATION-WIDE BASIS.

3. MHTC SET TO WORK WITH AREA UNIVERSITIES AND COLLEGES TO ANALYZE THEIR PROBLEMS AND NEEDS. THIS LED TO A COUNCIL POLICY TO FOCUS ON EQUIPMENT AND FACULTY NEEDS THAT WOULD EXPAND TEACHING CAPACITY AND IMPROVE THE QUALITY OF EDUCATION. THE "2% SOLUTION" WAS CRAFTED BY WHICH MEMBER COMPANIES PLEDGED TO CONTRIBUTE 2% OF THEIR R&D EXPENDITURES TO TECHNICAL HIGHER EDUCATION PROGRAMS. THIS WORKED EVEN BETTER THAN EXPECTED. LAST YEAR MEMBER

FIRMS - WHO WERE EXPECTED UNDER THIS ARRANGEMENT TO PROVIDE $15 MILLION TO EDUCATION - ALLOCATED $40 MILLION TO HIGHER EDUCATION PROJECTS. THESE RESULTS WERE STIMULATED IN GREAT PART BY THE BROADENING OF R&D TAX CREDITS AND LIBERALIZED DEDUCTIONS FOR EQUIPMENT DONATIONS.IN THE ECONOMIC RECOVERY ACT OF 1981.

4. NUMEROUS OTHER PROGRAMS TO PROVIDE CAREER TRANSITIONS TO HIGH TECHNOLOGY AND CAREER AWARENESS WERE INITIATED. A TECHNICAL WRITING PROGRAM WAS STARTED AT THE MIDDLESEX COMMUNITY COLLEGE; A COMPUTER PROGRAMMING COURSE FOR TEACHERS WAS INITIATED; A PROJECT FOR RETRAINING UNEMPLOYED MUNICIPAL WORKERS IN COMPUTER AIDED DESIGN WAS CREATED; A "WOMEN IN ENGINEERING" PILOT PROGRAM IN COOPERATION WITH NORTHEASTERN UNIVERSITY WAS ESTABLISHED; AN EFFORT TO CREATE A CURRICULUM IN TECHNICAL FIELDS WAS COMPLETED BY MHTC WHICH REFLECTED SKILL AND KNOWLEDGE REQUIREMENTS OF INDUSTRY; A K-12 COMMITTEE WAS FOUNDED TO STUDY WAYS OF ASSISTING PRIMARY AND SECONDARY EDUCATION. THESE INITATIVES ARE WORKING AS WELL.

5. FOLLOW-UP EFFORTS WERE UNDERTAKEN TO BUILD ON THE EXPERIENCES OF SUCCESSFUL CORPORATE/UNIVERSITY PROGRAMS.

A DAY-LONG CONFERENCE BETWEEN EDUCATORS AND INDUSTRIALISTS INCLUDED WORKSHOPS ON "HOW-TO" DEVELOP UNIVERSITY RELATIONS AND HOW UNIVERSITIES SHOULD APPROACH INDUSTRY FOR HELP AND SUPPORT.

THE EFFORTS OF MHTC LED TO MEETINGS AMONG UNIVERSITY ENGINEERING DEANS FROM PUBLIC AND PRIVATE INSTITUTIONS TO EXCHANGE VIEWS ON COMMON PROBLEMS AND CONCERNS. THESE CONTACTS LED TO A VERY IMPORTANT DECISION TO FOUND THE MASSACHUSETTS TECHNOLOGY PARK, AND LEGISLATION WAS AUTHORIZED IN 1982 TO PROVIDE $20 MILLION IN STATE MATCHING FUNDS TO FUND A RESEARCH AND TEACHING MICROELECTRONICS FACILITY. EIGHT UNIVERSITIES WOULD SHARE MICROELECTRONIC RESOURCES WHICH NO SINGLE UNIVERSITY COULD AFFORD ON ITS OWN.

A COLLABORATIVE PROGRAM BETWEEN THE UNIVERSITY OF MASSACHUSETTS AND BOSTON PRIVATE SCHOOLS WAS STARTED TO PROMOTE PUBLIC FINANCED ENGINEERING EDUCATION IN PRIVATE SCHOOLS.

THESE EFFORTS HAVE COMBINED IN A FEW YEARS TO OPEN NEW LINES OF COMMUNICATIONS BETWEEN GOVERNMENT, INDUSTRY AND ACADEMIA. THE RESULT IS EVIDENT IN CONSTRUCTIVE WORKING

RELATIONSHIPS FOCUSED ON PROBLEMS OF MUTUAL CONCERN. THE MOST TANGIBLE RESULTS ARE THAT STATE HIGHER EDUCATION AS WELL AS PRIVATE UNIVERSITIES ARE NOW MORE FOCUSED ON THE NEEDS OF THE HIGH TECHNOLOGY INDUSTRY, AND THAT THE TAX BURDEN IN THE STATE IS NOW MORE COMPETITIVE WITH OTHER STATES. A LESS TANGIBLE BUT IMPORTANT RESULT IS THAT MHTC PROVIDES A CENTER FOR COMMUNICATIONS BOTH INSIDE AND OUTSIDE THE HIGH TECHNOLOGY INDUSTRY. A MECHANISM FOR THE INDUSTRY TO ARTICULATE ITS CONCERNS, TO NEGOTIATE TRADEOFFS AND TO PROVIDE LEADERSHIP WHERE APPROPRIATE HAS PROVEN TO BE A POWERFUL BENEFIT TO THE INDUSTRY AS WELL AS TO OTHER INSTITUTIONS WHICH INTERFACE WITH THE INDUSTRY.

OBSTACLES TO FUTURE STATE GROWTH

WHILE PROGRESS HAS BEEN MADE AND THE RESULTS ARE SIGNIFICANT, CHALLENGES AND OBSTACLES TO FUTURE GROWTH STILL REMAIN. AGGRESSIVE CAMPAIGNS ARE UNDERWAY IN MANY STATES TO DEVELOP THE CONDITIONS NECESSARY FOR THE LOCATION AND EXPANSION OF HIGH TECHNOLOGY ENTERPRISES. AND COMPETITION IN A GLOBAL MARKET FROM BOTH DEVELOPED NATIONS LIKE JAPAN AND NEWLY INDUSTRIALIZING COUNTRIES LIKE TAWAIN AND KOREA IS INTENSIFYING.

GIVEN THESE INCREASED PRESSURES, WHAT OBSTACLES DOES MASSACHUSETTS FACE IN THE YEARS AHEAD?

THREE PROBLEMS ARE PARTICULARLY TROUBLESOME. ITS DEMOGRAPHIC PROFILE SHOWS A LARGER THAN AVERAGE DECLINE IN ENTRY LEVEL YOUTHS; MIGRATION PATTERNS ARE NOT BRINGING ENOUGH NEW PEOPLE TO THE STATE; ENGINEERING EDUCATION IS IN NEED OF EQUIPMENT AND MONEY TO PROVIDE NEEDED LONG-TERM GROWTH WHILE CORRECTING NEAR TERM QUALITY PROBLEMS AND STATE POLICIES ARE STILL NOT WELL-TUNED TO THE NEEDS OF THE INDUSTRY IN CREATING A COHERENT LONG-TERM ECONOMIC DEVELOPMENT STRATEGY THAT LINKS ACADEMIA, INDUSTRY, AND GOVERNMENT INTO AN EFFECTIVE PARTNERSHIP.

DEMOGRAPHICS. DURING THE REMAINING YEARS OF THE 80's, THE DEMOGRAPHIC PROFILE OF THE POPULATION WILL CONTINUE TO REFLECT DECLINING NUMBERS OF YOUNG PEOPLE. IT IS THESE YOUNG ENTRY LEVEL WORKERS, ESPECIALLY AT THE PROFESSIONAL LEVEL, WHICH ARE THE RAW MATERIAL NEEDED FOR INDUSTRY GROWTH. THE POOL OF HIGH SCHOOL GRADUATES NATIONWIDE IS EXPECTED TO DECLINE BY 20% BY 1990, ACCORDING TO THE WESTERN INTERSTATE COMMISSION FOR HIGHER EDUCATION. IN MASSACHUSETTS THE DECLINE WILL BE MUCH HIGHER WITH APPROXIMATELY 38% FEWER HIGH SCHOOL GRADUATES IN 1990. THIS LARGER THAN AVERAGE DECLINE IS DUE TO A SIGNIFICANT OUT-MIGRATION OF CHILD-BEARING AGE PEOPLE TO WARMER AND HEALTHIER GROWTH REGIONS IN THE NATION.

CONTINUED GROWTH BY MASSACHUSETTS BASED HIGH-TECHNOLOGY COMPANIES MAY BE INHIBITED BY A DIMINISHING SUPPLY OF YOUNG PEOPLE. OR ALTERNATIVELY IT MAY FORCE COMPANIES TO INVEST HIGHER AMOUNTS OF MONEY IN JOB RETRAINING FOR ADULT WORKERS CURRENTLY IN UNRELATED FIELDS.

MIGRATION. BECAUSE OF RAPIDLY RISING COSTS OF PRIVATE EDUCATION AND HEAVY CONCENTRATION OF PRIVATE HIGHER EDUCATION INSTITUTIONS IN MASSACHUSETTS (AND NEW ENGLAND), SOME REPORTS ARE FORECASTING INCREASED DIFFICULTY IN ATTRACTING OUT-OF-STATE STUDENTS TO COME TO MASSACHUSETTS. THE IMPORTANCE OF HIGHER EDUCATION TO CORPORATE GROWTH IS SUGGESTED IN A STUDY OF NEW HIRES OF 61 MHTC COMPANIES WITH COMBINED SALES OF $7.8 BILLION IN 79-80. SEVENTY-FIVE PER CENT OF THE NEW TECHNICAL EMPLOYEES HAD EITHER COLLEGE OR ADVANCED DEGREES. ABOUT ONE-THIRD WERE HIRED DIRECTLY FROM SCHOOLS. SINCE LOCALLY EDUCATED STUDENTS HAVE IN THE PAST OFTEN OPTED FOR EMPLOYMENT AND RESIDENCE IN THE STATE, A DECREASE IN THE ATTRACTIVENESS OF THE STATE COULD INDIRECTLY IMPACT THE ECONOMY. OTHER OBSERVERS, SUCH AS LYNN BROWNE AT THE FEDERAL RESERVE, BELIEVE THAT EVEN IF THEIR IS NET IN-MIGRATION INDUCED BY THE HEALTHY REGIONAL ECONOMY, IT WILL NOT MAKE UP FOR LOWER THAN NATIONAL NATURAL RATES OF POPULATION GROWTH. "THE

ENTIRE HISTORY OF THE UNITED STATES," SHE WRITES, "SHOWS A TENDENCY FOR PEOPLE TO SEEK MILDER CLIMATES AND OPEN SPACES. THE IMPROVEMENT IN ECONOMIES OF THE SOUTH HAS REINFORCED THEIR BASIC ATTRACTION. IN CALIFORNIA, ON THE OTHER HAND, THE INCREASED COST OF HOUSING MAY BECOME A DETERRENT."

FOR MASSACHUSETTS THIS MEANS THAT A MUCH LARGER PERCENTAGE OF HIGH SCHOOL GRADUATES MUST BE ATTRACTED INTO TECHNICAL EDUCATION. BUT AS ONE DIGS DEEPER INTO THE BARREL, ONE ENCOUNTERS A NATION-WIDE PROBLEM OF DECLINING COMPETENCES IN MATH AND SCIENCE IN OUR PUBLIC SCHOOLS. THE PRESENT PRACTICE OF SKIMMING THE CREAM WILL NO LONGER BE SUFFICIENT TO MEET THE STATE'S NEEDS. LOCAL INITIATIVES MUST BE DEVELOPED TO CORRECT THIS PROBLEM.

ENGINEERING EDUCATION. ENGINEERING EDUCATION SHORTCOMINGS AND THEIR POTENTIAL IMPACT ON THE ELECTRONICS AND COMPUTER INDUSTRY ARE SEVERE. A DECADE OF INFLATION HAS DRAINED THE FINANCIAL STRENGTH OF OUR PRIVATE UNIVERSITIES SO THAT THEY ARE INCAPABLE OF KEEPING PACE WITH SOARING SALARIES IN INDUSTRIES AND OF EXPANDING AND MODERNIZING TECHNICAL AND RESEARCH LABORATORIES TO TRACK RAPIDLY CHANGING TECHNOLOGY. BECAUSE OF THE

HISTORICAL STRENGTH OF THE PRIVATE SECTOR, PUBLIC FUNDING OF HIGHER EDUCATION RANKS LAST AMONG THE FIFTY STATES AND ENGINEERING EDUCATION IN THE PUBLIC SECTOR REPRESENTS A SMALL FRACTION OF TOTAL ENGINEERING GRADUATES..

IN SOME INSTITUTIONS SUCH AS THE UNIVERSITY OF MASSACHUSETTS, STUDENTS RATIOS TO ACCESSIBLE COMPUTER TERMINALS ARE MEASURED IN SEVERAL HUNDREDS TO ONE. AT NORTHEASTERN STUDENTS MUST LINE UP FOR LENGTHY PERIODS TO GAIN ACCESS TO COMPUTER TERMINALS AND ARE ALLOCATED NO MORE THAN 60 MINUTES TO COMPLETE ASSIGNMENTS. IN BOTH THESE UNIVERSITIES THE NUMBERS OF STUDENTS PER FACULTY ROSE BY 54.1% AND 41.5% RESPECTIVELY DURING THE LAST THREE YEARS OF THE 70s - A PROBLEM COMMON TO MANY UNDERSTAFFED DEPARTMENTS. IN OTHER CASES, LABORATORY EQUIPMENT IS SEVERAL GENERATIONS BEHIND WHAT IS CONSIDERED STATE-OF-THE-ART IN INDUSTRY. SUCH DEFICIENCIES CANNOT PERSIST WITHOUT HAVING A DELETERIOUS EFFECT ON THE REGIONAL HIGH TECHNOLOGY ECONOMY AND ITS POSTURE AMONG WORLD COMPETITORS.

NATIONAL IMPLICATIONS

IF BY HIGH TECHNOLOGY EMPLOYMENT WE REFER TO THOSE INDUSTRIES IN WHICH RESEARCH AND KNOWLEDGE ARE KEY INGREDIENTS TO PRODUCT DEVELOPMENT, THEN THE MUCH BANDIED SOLUTION MUST BE

CONSIDERED WITH GREAT CAUTION. THE MASSACHUSETTS EXPERIENCE SUGGESTS THAT ONE KEY INGREDIENT IS NECESSARY TO THE BIRTH, LIFE AND MATURING OF A HIGH TECHNOLOGY SECTOR. THIS INGREDIENT IS THE UNIVERSITY OR COLLEGE INFRASTRUCTURE THAT CAN BE BOTH A PRODUCER OF SKILLED MANPOWER AND A MAGNET FOR SKILLED MANPOWER TO IN-MIGRATE. IN THE ABSENCE OF THIS BASIC INGREDIENT, THE POTENTIAL FOR BUILDING A HIGH TECHNOLOGY INDUSTRIAL BASE IS GREATLY DIMINISHED.

THE UNIVERSITY IMPERATIVE:

NORTH CAROLINE'S EMERGENCE AS A "HIGH-TECH" STATE WITH ITS RESEARCH TRIANGLE PARK THAT NOW COUNTS ABOUT 20,000 HIGH TECHNOLOGY-RELATED JOBS, WAS A RESULT OF A STEADY TWENTY-YEAR PROGRAM TO CAPITALIZE ON A RESOURCE OF FIVE IMPORTANT UNIVERSITIES IN THE STATE. TODAY THESE INSTITUTIONS AND THE RESEARCH TRIANGLE INSTITUTE ARE LINKED TOGETHER THROUGH A NEW GOVERNMENT FINANCED $25 MILLION MICROELECTRONICS CENTER LOCATED IN THE TRIANGLE. ITS OPENING COINCIDES WITH A DECISION BY THE GENERAL ELECTRIC CORPORATION TO BUILD A $100 MILLION SEMICONDUCTOR FACILITY NEARBY.

SOME STATES HAVE NOT FULLY CAPITALIZED ON THEIR EDUCATIONAL RESOURCES. IN ILLINOIS, WHERE THE UNIVERSITY OF ILLINOIS, NORTHWESTERN UNIVERSITY AND PURDUE UNIVERSITY ARE NET

EXPORTERS OF ENGINEERING GRADUATES, THE CHICAGO AREA HAS A REALISTIC POTENTIAL OF BUILDING A HIGH TECHNOLOGY INDUSTRIAL BASE LINKED TO THESE AND OTHER INSTITUTIONS. CURRENT PLANS TO CREATE A "SILICON CORRIDOR" FROM CHICAGO TO ROCKFORD RECOGNIZE THE LONG IGNORED VALUE OF THIS ASSET.

IN MICHIGAN, ON THE OTHER HAND, WHERE FUNDS ARE BEING ACCUMULATED TO FOUND BOTH A ROBOTICS CENTER AND BIOTECHNOLOGY RESEARCH CENTER, THE CHANCES OF SUCCESS ARE JEOPARDIZED IN PART BY THE ABSENCE OF A STRONG EDUCATIONAL BASE UPON WHICH TO LEVERAGE A NEW INDUSTRIAL INFRASTRUCTURE AND BY OVERPRICED UNIONIZED LABOR. IN ADDITION A RELUCTANCE OF THE CURRENT STATE LEADERSHIP TO TACKLE THE NEEDED PUBLIC INVESTMENT IN EDUCATION - BECAUSE OF THE STATE'S DIRE FINANCIAL CONDITION - ALSO BRINGS INTO QUESTION THE PROSPECTS OF BUILDING MOMENTUM INTO A NEW HIGH TECHNOLOGY ECONOMIC SECTOR.

TWO OPTIONAL HIGH TECH FUTURES:

WHAT THEN ARE THE OPPORTUNITIES FOR THOSE STATES OR REGIONS THAT DO NOT HAVE A WELL DEVELOPED TECHNICAL HIGHER EDUCATION INFRASTRUCTURE?

RE-DEFINING "HIGH-TECHNOLOGY": THE NEW TOOLMAKERS

A DECADE AGO, THE FOXBORO CORPORATION, IN MASSACHUSETTS, WAS AN OLD-INDUSTRY THAT HAD FULLY MATURED. IT COULD CONTINUE

WITHOUT CHANGE AND RAPIDLY DECLINE AS A SUPPLIER OF FLOW CONTROL AND MEASURING DEVICES, OR MODERNIZE AND ATTEMPT TO RETAIN A POSITION AS A DOMINANT SUPPLIER IN THE WORLD MARKET.

TEN YEARS AGO THE DECISION WAS MADE TO MODERNIZE. TODAY THE FIRM COULD STILL BE CHARACTERIZED BY MANY AS AN OLD INDUSTRY BUT WITH ONE CRUCIAL DIFFERENCE. MODERN NEW TOOLS - COMPUTERS - HAVE BEEN INTRODUCED TO THE FIRM. ONE EXAMPLE IS A COMPUTER AIDED DESIGN OPERATION, STARTED TWO YEARS AGO, AND WHICH IS USED BY THE MODEL-MAKING SHOP TO PLAN AND MAKE COMPLEX METAL PARTS. TECHNICIANS WHO ONCE WORKED WITH THEIR HANDS ON OILY LATHES AND OTHER MACHINE TOOLS ARE NOW COMPLETING THE MODELING TASKS ON GRAPHIC TERMINALS. PRODUCTIVITY HAS BEEN INCREASED, JOB TASKS (ONCE CALLED BLUE-COLLAR) HAVE BEEN UPGRADED, AND MORE COMPLEX DEVICES CAN BE INSPIRED "ON SCREEN".

THIS SIMPLE CASE REPRESENTS IN LARGE PART THE "HIGH-TECH" OPPORTUNITY FOR MANY TRADITIONAL MANUFACTURING INDUSTRIES AROUND THE NATION - FROM STEEL TO TEXTILES TO SHOES. IT ALSO REPRESENTS AN OPPORTUNITY FOR A VAST ARRAY OF SERVICE JOBS IN WHICH PAPER-WORK, REPORT WRITING, OR ARITHMETIC CALCULATIONS ARE PART OF THE WORK DAY.

FROM THIS PERSPECTIVE WE CAN VIEW THE HIGH TECHNOLOGY INDUSTRY AS THE TOOLMAKERS OF THE 80's AND 90's. HIGH TECH PRODUCTS LIKE WORD PROCESSORS, ROBOTS AND COMPUTER AIDED DESIGN AND MANUFACTURING EQUIPMENT PUT THE LATEST TECHNOLOGY IN THE HANDS OF OUR WORKERS IN ALL SEGMENTS OF THE ECONOMY - WORKERS IN GOVERNMENT, HOSPITALS, BANKS, INSURANCE COMPANIES, UNIVERSITIES, FACTORIES - WORKERS EVERYWHERE.

SO NOT ALL WORKERS WILL BE ENGAGED IN DESIGNING AND MANUFACTURING COMPUTERS AND OTHER HIGH TECH TOOLS BUT A VERY LARGE NUMBER WILL END UP USING THEM TO IMPROVE THEIR PRODUCTIVITY. IN 1982, ONE-HALF THE CAPITAL EQUIPMENT INVESTMENTS IN AMERICA WERE FOR COMPUTERS, COMMUNICATIONS, INSTRUMENTS, AND OTHER ELECTRONIC EQUPMENT - UP FROM ONE-QUARTER IN 1972 AND ONE-THIRD IN 1977. THUS THE IMPACT OF HIGH TECHNOLOGY PRODUCTS ON CREATING NEW JOBS AND IN RETAINING OLD JOBS IS ALREADY A VERY SIGNIFICANT FACTOR IN OUR ECONOMY.

ATTRACTING THE DISPERSED EMPLOYMENT OF HIGH-TECH

TWO TYPES OF EMPLOYMENT ARE GEOGRAPHICALLY DISPERSED BY THE GROWTH OF HIGH TECHNOLOGY INDUSTRIES. THE FIRST, AN ARRAY OF COMPUTER RELATED SERVICE JOBS SUCH AS DATA PROCESSING AND SOFTWARE

DEVELOPMENT, WHICH WHILE CURRENTLY SMALL ARE GROWING RAPIDLY. THE SECOND IS THE DIFFUSION OF EMPLOYMENT THROUGH THE DECENTRALIZATION OF HIGH TECHNOLOGY FIRMS. SALES OFFICES, MAINTENANCE AND SERVICE CENTERS, SECONDARY MANUFACTURING SITES ALL HAVE THE EFFECT OF DISTRIBUTING EMPLOYMENT THROUGHOUT THE REGION OR NATION.

IN ITS RECENT STUDY ON HIGH TECHNOLOGY AND BUSINESS SERVICES, THE FEDERAL RESERVE BANK OF BOSTON ARGUED THAT "POLICYMAKERS WHO WISH TO STIMULATE TECHNOLOGICAL DEVELOPMENTS MUST NOT TAKE A NARROW VIEW OF WHAT CONSTITUTES HIGH TECHNOLOGY". DURING THE SECOND HALF OF THE EIGHTIES SERVICE INDUSTRIES ASSOCIATED WITH ELECTRONICS, COMPUTERS AND THE NEW TOOLMAKER TECHNOLOGIES WILL BE "A MAJOR SOURCE OF EMPLOYMENT GROWTH IN THE NATION."

THESE SERVICES, WHICH BY THE END OF 1982 EMPLOYED 350,000 PEOPLE IN SOFTWARE AND DATA PROCESSING TASKS NATIONWIDE, ARE OFTEN CLUSTERED NEAR THE END-USER. SINCE COMPUTER USERS FREQUENTLY NEED APPLICATIONS CLOSELY TAILORED TO THEIR ACTIVITIES, PROXIMITY OF THE SERVICE SUPPLIERS IS IMPORTANT. A RAPID DECLINE IN THE PRICE OF COMPUTER HARDWARE AND NEW GENERATIONS OF MORE POWERFUL MEMORY AND COMPUTATIONAL POWER IMPOSE MORE AND MORE DEMANDS ON THE

SOFTWARE AND DATA PROCESSING SERVICE SECTOR. THE PROLIFERATION OF USERS IS ONE REASON FOR OPTIMISTIC PROJECTIONS OF FUTURE EMPLOYMENT IN THESE FIELDS.

MAJOR MANUFACTURERS OF HIGH TECHNOLOGY PRODUCTS EMPLOY A LARGE NUMBER OF PEOPLE IN FIELD OFFICES. FOR EXAMPLE, TWENTY-FIVE PERCENT OF THE EMPLOYEES OF MANY COMPUTER COMPANIES ARE IN SALES AND SERVICE JOBS DISTRIBUTED WIDELY ACROSS THE COUNTRY IN EVERY MAJOR CITY. SIMILARLY DECENTRALIZED MANUFACTURING CENTERS BRING EMPLOYMENT OPPORTUNITIES TO MANY SUB-REGIONS THROUGHOUT THE NATION. EXAMPLES OF THIS SORT OF DISPERSAL ARE ALREADY OCCURING IN VERMONT, IDAHO, OREGON, AND COLORADO.

THE ROAD AHEAD

THE PROLONGED RECESSION HAS BROUGHT INTO SHARP FOCUS AMERICA'S ROLE AS PART OF A GLOBAL ECONOMY IN WHICH WE ARE UP AGAINST SOME TOUGH AND COMPETENT COMPETITORS. AT THE SAME TIME, IT IS CLEAR THAT HIGH TECH INDUSTRIES ARE SPEARHEADING A MAJOR CHANGE IN OUR ECONOMY, BOTH BY CREATING NEW INDUSTRIES AND BY REVITALIZING OLD ONES. THE MOST VIABLE COURSE FOR AMERICAN POLICYMAKERS IN THE COMING YEARS IS TO PROMOTE KNOWLEDGE-INTENSIVE, HIGH TECHNOLOGY PRODUCTS NOT ONLY AS A SOURCE

OF EMPLOYMENT AND EXPORTS BUT EQUALLY AS IMPORTANT AS A MEANS OF INCREASING THE PRODUCTIVITY OF OUR WORKERS IN ALL SEGMENTS OF THE ECONOMY.

BUT AS WITH THE MASSACHUSETTS CASE, THE CONTINUED RAPID GROWTH OF THIS INDUSTRY IS BEING THREATENED BY A LACK OF PEOPLE WITH THE RIGHT EDUCATION AND TRAINING. HIGH TECH FIRMS ARE PEOPLE INTENSIVE. HUMAN RESOURCES COSTS IN HIGH TECH COMPANIES REPRESENT 40-45% OF THE SALES REVENUES IN ELECTRONICS, COMPARED TO 20% FOR AN ALL INDUSTRY AVERAGE AND ONLY 6% IN OIL COMPANIES. IN ADDITION, THE KNOWLEDGE-INTENSITY OF THE WORK-FORCE IS UNPRECEDENTED. ONE-THIRD OF THOSE EMPLOYED HAVE COLLEGE DEGREES OF WHICH MORE THAN ONE-HALF ARE TECHNICAL; ANOTHER THIRD REQUIRE ASSOCIATE DEGREES OR THE EQUIVALENT OF TWO OR MORE YEARS OF EDUCATION BEYOND HIGH SCHOOL.

THE ELECTRONICS AND COMPUTER INDUSTRY HAS THE GREATEST DEMAND FOR ELECTRICAL ENGINEERING GRADUATES WHO ACCOUNT FOR ABOUT 25-30% OF ALL ENGINEERING GRADUATES. AT PRESENT THE ELECTRICAL ENGINEERING WORK-FORCE TOTALS ABOUT 200,000. THE NATIONAL CENTER FOR EDUCATION STATISTICS ESTIMATES THAT NEW GRADUATES WILL INCREASE THE WORK-FORCE BY ABOUT 8% PER YEAR THROUGH 1985.

HOWEVER, ABOUT 6% A YEAR RETIRE OR LEAVE FOR CAREERS IN MANAGEMENT, SALES, MARKETING AND MANUFACTURING. THIS LEAVES NET GROWTH AT ABOUT 2%.

DEMAND IN THE ELECTRONICS AND COMPUTER INDUSTRY WILL GROW AT A RATE OF ABOUT 2.6% ACCORDING TO THE BUREAU OF LABOR STATISTICS. BUT THIS DOES NOT ACCOUNT FOR THE LARGE BUILD-UP IN DEFENSE PROCUREMENTS OF ENGINEERING-INTENSIVE PRODUCTS, OR FOR THE GROWING PERVASIVENESS OF ELECTRONICS IN AN ARRAY OF CONSUMER GOODS FROM CARS TO VIDEO-GAMES. IT IS NOT HARD TO IMAGINE THAT GROWTH IN THE LAST HALF OF THE 80s WILL BE MORE LIKE THE 60s WHEN IT AVERAGED 5%.

SUCH A GROWTH RATE WOULD REQUIRE A DOUBLING OF THE OUTPUT OF ELECTRICAL ENGINEERS BUT TODAY THE PROSPECTS OF ACHIEVING THIS GOAL ARE DIM. WHILE UNDERGRADUATE ENROLLMENT DEMAND IS BOOMING IN ENGINEERING, FACULTY AND LABORATORY FACILITIES ARE NOT GROWING PROPORTIONALLY. THEREFORE MANY SCHOOLS ARE VIRTUALLY CAPPING ENGINEERING ENROLLMENTS. THIS YEAR, PURDUE CAPPED ITS ENROLLMENT AT 1,500; AT THE UNIVERSITY OF TEXAS IN AUSTIN, UNDERGRADUATE ENROLLMENTS WILL BE DECREASED; AT THE UNIVERSITY OF ILLINOIS, FACULTY OVERLOADS ARE 40% ABOVE THE NORM. AT THE UNIVERSITY OF

SOUTH CAROLINA, ENROLLMENT IS CAPPED SINCE INFLATION ADJUSTED FUNDING IS DOWN 10% IN A DECADE, YET THE NUMBER OF STUDENTS HAS INCREASED BY 40% IN THE SAME PERIOD. AT OREGON STATE UNIVERSITY THE DEPARTMENT OF ELECTRICAL ENGINEERING HAD 180 QUALIFIED APPLICANTS AND ROOM FOR ONLY 80. THESE EXAMPLES ARE MULTIPLIED MANY TIMES OVER ACROSS THE NATION. THIS MEANS:

A) THAT STATE GOVERNMENTS WILL HAVE TO REALLOCATE EXISTING HIGHER EDUCATION RESOURCES, AND TO ADD NEW RESOURCES AS REQUIRED TO BETTER PREPARE PEOPLE FOR THE JOBS AND CAREERS THAT ARE HERE NOW AND THAT ARE COMING DOWN THE PIKE.

B) THAT STATE GOVERNMENTS WILL HAVE TO DEVELOP COMPREHENSIVE STATE-WIDE PLANS THAT COORDINATE THE NEEDS OF BOTH PUBLIC AND PRIVATE INSTITUTIONS IN AN ERA OF DECLINING ENROLLMENTS.

C) THAT STATE AND LOCAL GOVERNMENTS WILL HAVE TO TAKE AGGRESSIVE AND BOLD NEW INITIATIVES TO CORRECT THE EDUCATIONAL DIFFERENCES IN K THROUGH 12, ESPECIALLY RELATED TO TECHNICAL EDUCATION.

D) THAT INDUSTRY MUST BECOME MORE INVOLVED WITH EDUCATION BY IDENTIFYING JOB REQUIREMENTS AND EDUCATION AND TRAINING NEEDS TO MEET THESE REQUIREMENTS, AND BY PROVIDING DIRECTION AND FINANCIAL SUPPORT TO EDUCATIONAL INSTITUTIONS.

E) THAT FEDERAL SUPPORT SHOULD BE MADE AVAILABLE TO ENCOURAGE AND SUPPORT GROWING INDUSTRY/UNIVERSITY RELATIONSHIPS AS WELL AS TO FUND UNIVERSITY R&D THROUGH TRADITIONAL CHANNELS.

THESE STEPS WOULD BEGIN TO DEVELOP A MORE COHERENT LINKAGE OF EDUCATION AND ECONOMIC GROWTH PROGRAMS. IN SOME STATES SUCH AS NORTH CAROLINA SUCH EFFORTS HAVE BEEN ON-GOING FOR A LONG TIME WITH LAUDABLE AND DEMONSTRABLE RESULTS; IN MASSACHUSETTS WE ARE BEGINNING TO FORGE STRONGER LINKS; IN OTHER STATES MAJOR INITIATIVES OF THIS SORT ARE UNDERWAY. AT THE FEDERAL LEVEL, HOWEVER, A BIG GAP STILL EXISTS IN THE STATED EXPECTATIONS OF THE CURRENT ADMINISTRATIONS AND THE NEEDS AS I HAVE OUTLINED HERE.

ONE STEP IN THE RIGHT DIRECTION, WOULD BE TO INSTITUTIONALIZE PARTNERSHIPS THROUGH MATCHING GRANTS THAT

COMBINE FEDERAL, STATE AND INDUSTRY SOURCES. THIS WAS THE BASIS FOR THE LEGISLATIVE INITIATIVE I HELPED FORMULATE UNDER THE TITLE "A HIGH TECHNOLOGY MORRILL ACT", A BILL THAT WAS FILED IN THE SENATE BY SENATORS PAUL TSONGAS AND JOHN STENNIS IN MARCH OF THIS YEAR AS S-631, AND WHICH WILL BE FILED SOON IN THE HOUSE UNDER THE SAME NAME. ASPECTS OF THAT BILL HAVE NOW BEEN INCORPORATED INTO THE PELL/STAFFORD BILL UNDER TITLE III WHICH CALLS FOR A MATCHING FUNDS PARTNERSHIP OF A SIMILAR SORT. IN THE LATTER CASE, HOWEVER, THE AUTHORIZED FUNDING LEVEL FALLS FAR SHORT OF THE MINIMAL NEED CONSERVATIVELY ESTIMATED BY MANY DISTINGUISHED LEADERS IN ENGINEERING EDUCATION. THEY CALCULATE A $1 BILLION NEED FOR EQUIPMENT, FACULTY SALARIES, AND GRADUATE FELLOWSHIPS TO BRING THE 300 OR SO ENGINEERING DEPARTMENTS UP TO THE REQUIRED CAPACITY. THE HIGH TECH MORRILL ACT WAS DESIGNED TO MEET THAT NEED WITH AN AUTHORIZATION OF $500 FEDERAL DOLLARS TO BE MATCHED BY STATES AT A RATE OF $3 OF STATE MONEY AND $2 OF INDUSTRY MONEY FOR EVERY $5 FROM THE FEDERAL GOVERNMENT.

INDUSTRY IN THIS FORMULATION WOULD PLAY A BOTTOMS UP ROLE OF DETERMINING EDUCATION PRIORITIES IN CONCERT WITH ACADEMIC INSTITUTIONS. THESE WOULD THEN BE AIDED BY STATE AND FEDERAL FUNDING. IT SHOULD BE REMEMBERED THAT EDUCATION ABSORBS ALMOST

$220 BILLION A YEAR AT ALL LEVELS. OF THIS AMOUNT 30% IS EXPENDED ON HIGHER EDUCATION; AND OF THAT PORTION ABOUT $7-9 BILLION IS SPENT YEARLY IN ENGINEERING EDUCATION. AT PRESENT INDUSTRY SUPPORT ACCOUNTS FOR A VERY SMALL PORTION OF ALL SOURCES OF FUNDS TO ALL HIGHER EDUCATION - ONLY 1-2%; AND ONLY 4-5% OF ALL R&D SUPPORT TO ENGINEERING AND SCIENCE LABORATORIES IN UNIVERSITIES. IT SHOULD BE CLEAR THAT EVEN A MUCH LARGER GIVING RATE BY INDUSTRY CANNOT ALONE MAKE UP FOR THE HUGE SHORTFALL THAT EXISTS IN ENGINEERING EDUCATION. IT IS FOR THIS REASON THAT A COOPERATIVE PROGRAM OF MATCHING GRANTS, LEVERAGING FEDERAL, STATE AND INDUSTRY SOURCES, WOULD BE DESIRABLE AND BENEFICIAL TO THE NATION.

INDUSTRY IS SHOWING A WILL TO LEAD AND TO SUPPORT HIGHER EDUCATION. IT IS PROVIDING FUNDS, MANPOWER AND DIRECTION. IT CANNOT AND SHOULD NOT BE EXPECTED TO DO SO ALONE - IF ONLY BECAUSE THE ECONOMIC FUTURE OF OUR NATION DEPENDS ON A COLLABORATIVE POOLING OF IDEAS, FUNDS AND INITIATIVE BY GOVERNMENT, INDUSTRY AND ACADEMIA.

Mr. MacKay [presiding]. Mr. Siegel.

[The biographical sketch of Mr. Siegel follows:]

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June 7, 1983

Lenny Siegel

Lenny Siegel has been director of the Pacific Studies Center, a non-profit public-interest information center in "Silicon Valley" since 1970. Since 1967, when he was a physics undergraduate at Stanford University, Mr. Siegel has been studying the military and civilian applications of high-technology electronics, the global division of labor in high technology industry, and the social, economic, and environmental problems of Silicon Valley.

At PSC, he has authored "Background Report on Silicon Valley" (for the U.S. Commission on Civil Rights, September, 1982) and "Delicate Bonds: The Global Semiconductor Industry" (January, 1981), and he co-authored "Silicon Valley: Paradise or Paradox?" (September, 1977). He writes and edits PSC's monthly Global Electronics Information Newsletter.

Mr. Siegel's recent magazine articles include: "Down in Silicon Valley" (Multinational Monitor, April, 1983); "Japanese Industry Moves to Close Software Gap" (Infoworld, June 14, 1982); "Space Wars" (Progressive, June 1982; "The Other Arms Race" (Christianity & Crisis, March 1, 1982); and "The Hazards of High Tech" (Environmental Action, July-August, 1981). He also writes sydicated articles on military electronics for Pacific News Service.

With John Markoff, Mr. Siegel is working on a book entitled, Where the Chips May Fall: The Promise and Peril of the Semiconductor Revolution. He has contributed articles on the electronics industry to Ten Years' Military Terror in Indonesia (Spokesman Books, 1975) and A House Divided (Little Brown, 1973).

From 1978 to 1981 Mr. Siegel served as a member of the Environmental Planning Commission for the City of Mountain View, in the heart of Silicon Valley.

Mr. Siegel. I am extremely pleased to have the opportunity to address the subcommittees today. I think these are issues that we are all affected by and so many of us seem to know so little about.

I am going to be summarizing my somewhat longer statement that I submitted in writing.

Silicon Valley, Calif., the belt of industrial communities at the southern edge of the San Francisco Bay, is known worldwide for its concentration of high technology computers, components, and communications companies. Silicon Valley, a term barely a dozen years old, has come to symbolize an amazing economic development success story.

Electronics employment in Santa Clara County, the statistical area which most closely matches Silicon Valley, nearly tripled over the past decade, rising from 61,500 in 1972 to 168,000 in 1982. As of 1981, some 215,700 people worked in Santa Clara County's high tech sector. Not only is the area a concentration of high-tech employment, but it is generally conceded to be the leading area worldwide for the startup of high technology companies. Hundreds of high-tech companies are formed virtually every year in the Valley.

Silicon Valley has in the media at least become a legendary promised land where college dropouts become multimillionaires, and where factories not only look like college libraries, but contain athletic facilities for their employees. In fact their success story is only part of the picture. High technology development has costs as well as benefits. The environmental and social problems unleashed by the rapid growth of Silicon Valley now are actually threatening the area's future economic vitality. For those areas throughout the country that are seeking high technology investment, it provides some lessons that can be used to model their own development plans and also as an indicator that the competition for high tech should not be necessarily as sharp as it is today.

One perception of the high technology industry is that everybody is an engineer who drives Porsches and lives in Los Altos. There are people who do that and make a good deal of money. Nationwide in the high-tech industry, about 28 percent of the personnel are managers or professionals. In Silicon Valley, with a concentration of companies' headquarters and R&D laboratories, the percentage is about 40 percent.

But typical production workers, who make up 40 or 50 percent of the work force, depending where you are, earn somewhere around $5 an hour. In Silicon Valley, the typical production worker is a single parent or, in some cases, a married parent, woman—chances are one out of two she is a Chicano, Vietnamese or Filipino. That is not too widely known about the industry.

What we have found over the years is that the stratification or what we call the bifurcation of the work force into a fairly wealthy high-status group and a fairly poorly paid low-status group has created an urban commute pattern which is somewhat unusual for the rest of the country. Typically, in a metropolitan area, the people who commute from the suburbs are the white-collar workers. In Silicon Valley, historically it is the production workers that have commuted the greatest distances, pay the greatest costs of commuting in time and money, and in the case of the single parent workers, work the greatest distance from their children, who in many cases don't even have child care.

The jobs and housing balance got so bad by 1977 that even industry and government recognized the problem. It was hard to recruit engineers to come into Silicon Valley from other parts of the country. People were commuting 30 miles or more to work. A series of commissions were set up to study the problem.

Those commissions came up with a number of reports, but very little has been done to solve the problem. Industry has continued to concentrate in the areas where it is established. And because the high technology people in northern Santa Clara County, the employees, the engineers, prefer to live in areas which are somewhat exclusive, it has been hard to increase housing in those areas.

Another problem, which surprises people to be in a place like Silicon Valley, is the hazardous chemical problem. Electronic production, whether the production of computers, largely through printed circuit-board manufacture, or semiconductors, which requires the repeated application of chemicals, is a chemical process generating extremely stable and hazardous heavy-metal toxic wastes. In general, the industry complies with the law, and the law complies with the state-of-the-art in the treatment of those materials. Nevertheless, it generates these extremely stable wastes which have to be trucked out. It is a long-term problem that has not been solved.

Better known in Silicon Valley at least is the problem of underground storage of chemicals. A little over a year ago a neighborhood of south San Jose discovered chemicals had entered their water supply and a number of the women in the neighborhood got together and discovered they had a higher than average birth defect rate. They are suing, accusing Fairchild of responsibility. It has not been established at this point. But the resulting investigation of chemical leakage in the Valley pointed out to the public at large that over 80 percent of those companies which have tested for leaks near their underground storage have had toxic leaks. Most have not entered the public water supply as yet, because most of the water supply is protected by a 200-foot layer of earth.

As a result, Silicon Valley cities and industry, which has taken a very active role in pursuing this model ordinance I am going to discuss, as well as environmental and labor groups, have pushed for the adoption of an ordinance in each city which would require double containment of hazardous materials from firms in the Valley. This is an ordinance which is not only important for Silicon Valley; any area considering attracting high-tech firms should look at it because it is much more effective if you have the technology and the requirements in place before the companies are there.

Another area which I will touch on briefly is the area of high-tech crime. Just as there are aspects of high-tech pollution which local governments are frequently not equipped to handle, there is crime, such as software theft, design theft, chip theft, which local law-enforcement agencies are not trained to handle.

How does a typical cop on the beat know someone has a bag of stolen chips? There is no way of recognizing what the software even is. Now, in Silicon Valley, the local agencies are trying to get together and finally to establish the capability to deal with these problems.

In each of these areas, I am not suggesting that high technology is not a viable economic development strategy for Silicon Valley or any other place. I am merely pointing out that there are costs that are frequently unknown by the agencies and communities that are trying to attract the industries.

I want to return to something which I addressed in the beginning of my paper, which is somewhat similar to a Massachusetts case—why does Silicon Valley have such a concentration of high-tech industry?

Unlike the aluminum industry which needs energy, or the steel industry which needs iron ore, what you need for high tech is brain power. First you need an educational institution of the caliber of MIT or Stanford University, in the case of Silicon Valley.

And second, you need a quality of life which will attract those people. These are people with some choices about where they are going to live. The climate in Silicon Valley, the amenities, have historically brought people to the valley. The industry will not be able to recruit engineers from St. Louis or Atlanta to come to Silicon Valley if those people think their kids are going to be drinking polluted water. Some of the issues, like pollution and congestion, are now threatening the growth of industry in the valley.

There are a number of policies at the State and local level which can obviously be generated in response to the problems that I have addressed. Planning so that housing which fits the work force is available near the factories is something which is very simple to do; but you have to do it ahead of time or else you develop a momentum where the companies need more room for expansion and the high-tech employees, the professionals, don't want the production workers moving in next door.

The model ordinance I mentioned for Silicon Valley's toxic-chemical problem is another area where it is possible for local agencies to develop the response to the problem before it emerges.

At the Federal level, there are also policies that can be developed. The first thing the Federal agencies can do, Congress can do, is recognize there is a problem, that high technology is not a panacea, it is not the answer to the Nation's economic problems. It is a part of an answer which has to be treated for its costs as well as its benefits.

In recognizing the imperfections, it is important to push for more research into the toxic wastes that are generated by the industry. It is important to help use Federal agencies to help establish uniform environmental standards relevant to the industry so communities don't compete with each other in relaxing their standards to attract the companies, which probably won't come for that reason anyhow.

Finally, an issue rarely discussed in discussions on high technology is enforcement of labor law. The high technology electronics industry is uniformly nonunion. Some of the problems, such as inadequate housing that face the workers, exposure to chemicals on the job, I think, could be solved if the work force were organized just as other more mature manufacturing industries in the country are organized.

I am not suggesting that the Federal Government come in and say you have to organize the industry. Rather, what we are asking for is a fair implementation of the labor laws to make sure that workers do in fact have that right to go ahead and organize.

Thank you very much.

[The prepared statement of Mr. Siegel follows:]

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SILICON VALLEY: THE ARCHETYPE OF HIGH-TECH DEVELOPMENT

(testimony prepared for the
Subcommittee on Science, Research, and Technology
of the House Committee on Science and Technology
and the Task Force on Education and Employment
of the House Budget Committee)

Silicon Valley, California, the belt of industrial communities at the southern edge of the San Francisco Bay, is known worldwide for its concentration of high-technology computer, components, and communications companies. "Silicon Valley," a term barely a dozen years old, has come to symbolize an amazing economic development success story.

Electronics employment in Santa Clara County, the statistical area which most closely matches Silicon Valley, nearly tripled over the past decade, rising from 61,500 in 1972 to 168,000 in 1982. As of 1981, some 215,700 people worked in Santa Clara County's high-tech sector, including 182,400 in manufacturing, 21,800 in services such as computer services and research and development, and 11,600 in high-tech wholesale trade and distribution. In 1981, there were 987 high-tech manufacturing firms in the County, 391 service firms, and 486 in trade. At least 20,000 more people work for Silicon Valley high-tech businesses in the adjacent counties of San Mateo and Alameda.

It is not surprising, therefore, that public officials, economic development agencies, and chambers of commerce from throughout the country see Silicon Valley as a model for increasing employment and building their tax base. Scarcely a week passes without another delegation visiting Silicon Valley, hoping to attract investments by high-tech firms.

Silicon Valley has become a legendary promised land in the national media, where college drop-outs become multimillionaires, and where factories not only look like college campuses but contain athletic facilities for their employees. In fact, the success story is only part of the picture. High-tech development has costs as well as benefits. In fact, the environmental and social problems unleashed by the rapid growth of Silicon Valley are now threatening the area's future economic vitality.

A Unique Economic Environment

Intel-founder Robert Noyce has said that Silicon Valley is in Santa Clara County because "That's where [transistor-inventor] Bill Shockley's mother lived." But by 1955, when Shockley recruited Noyce and other industry pioneers to his transistor firm in Palo Alto, the area was already becoming an important center of electronics production.

Since high-technology industries do not depend on large volumes of raw materials or energy, they tend to cluster in areas which have or can attract scientists and engineers. (Silicon, after all, is found virtually everywhere on the Earth's crust.) Stanford Provost and Engineering Dean Frederick Terman made the Santa Clara Valley an attractive area for high-tech business by consciously building what he called a "Community of Technical Scholars" after World War II. Terman brought bright young engineers to Stanford's engineering faculty and raised funds to build labs. The Federal Government, largely acting through the Pentagon, sponsored basic and applied research on the campus.

Terman also encouraged both Stanford faculty and graduates to turn their expertise to commercial advantage. He helped form spin-off firms and organized the Stanford Industrial Park, on university land, to provide land for the young high-tech firms. The university and its industrial community developed a symbiotic relationship. Stanford's engineering and science departments were soon recognized among the tops in the nation. Corporations that drew upon Stanford's brainpower rewarded the university with support.

By the 1960's, the Community of Technical Scholars had spread beyond Stanford's immediate environs, while large high-tech firms from outside the region moved branches to the Valley to take advantage of its expertise. Though Shockley's firm, located in the Stanford Industrial Park, failed, the team he brought to California formed Fairchild Semiconductor in nearby Mountain View, which over the years has supplied the personnel who have founded most of the semiconductor firms in Silicon Valley. Lockheed liked its small research lab in the Stanford park so much that it established the Lockheed Missiles and Space Company in nearby Sunnyvale. Lockheed is now the largest manufacturer in the Valley.

Terman's design would not have succeeded, of course, were it not for the quality of life in the area. The Santa Clara Valley promised young engineers a pleasant climate, suburban and rural lifestyles, and access to a variety of recreational resources. The Valley's once strong educational system not only provided companies with an educated workforce, but it attracted professionals with young families into the area.

By the 1970's, the Valley had become a breeding ground for industry unmatched anywhere. Dissatisfied employees with bright ideas could easily go across the street or across town to set up new ventures. The "Home-Brew Computer Club," a group of high-tech hobbyists, actually spawned the personal computer industry in the mid-1970's.

Silicon Valley has everything a high-tech start-up could want. With stock options, a new firm can hire bright professionals from existing firms. Specialized services, from graphics to law to printed circuit assembly, are found throughout the Valley. High-tech real estate developers provide ready-made offices, labs, and factories. Suppliers and vendors abound. And a flock of venture capitalists stands ready to back any promising venture with advice and hard cash. The Bank of America recently noted, "More than 3,000 small consulting firms exist in Santa Clara County, providing new firms with start-up expertise and continuing help over the early years of operation."

The Division of Labor

Though high-technology industry, by definition, relies on the brainpower of engineers and scientists, it also depends heavily on the labor of unskilled and semi-skilled workers. Since the earliest days of integrated circuit - silicon chip - production, U.S.-based open-market ("merchant") semiconductor firms have carried out most of their assembly - the attachment of silicon slivers to tiny gold wires and ceramic or plastic packages - in Asia. About as many young Asian women, working at a fraction of U.S. pay, work in the U.S. semiconductor industry as there are employees in the U.S. producing integrated circuits.

In the past few years, major American producers of computers and peripherals have established plants in the Far East to take advantage of low wage rates there. Game-maker Atari, a political symbol of high-technology industry, announced earlier this year that it was closing two major production lines in Silicon Valley while expanding production in Hong Kong and Taiwan. Most other high-tech equipment-producers, however, have managed to establish offshore production without closing their U.S. production lines.

Though the most labor-intensive high-tech work is done in Asia, Latin America, and the Caribbean, high-tech firms employ a surprisingly large number of low-skilled workers in the U.S. Nationally, in 1980, high-tech electronics firms employed 38% operatives, laborers, and service workers, plus 12% clerical workers. Managers and professionals made up 28% of the workforce, with the remaining 22% composed of technicians, craft workers, and sales workers.

Silicon Valley, with its concentration of headquarters, research facilities, and computer services, actually has a greater proportion of professionals. Silicon Valley's high-tech industry, including service categories as well as electronics, employed 23% operatives, laborers, and service workers in 1980. Clerical workers were 15% of the total. Managers and professionals made up 40% of the local high-tech workforce. Technicians, craft, and sales workers made up 23%.

Within high tech industry, status and pay differ markedly between job categories, and nowhere is this clearer than Silicon Valley. Production workers and professionals are miles apart in pay, culture, and residence. The typical semi-skilled production worker is a woman earning something around $5.00 per hour plus benefits, depending upon the company. Workers at her plant are not represented by a union. She has little chance of advancing, even to skilled production positions. Chances are 50-50 that she is Hispanic, Asian, or black. She probably lives in San Jose, especially if she has kids.

The typical engineer, on the other hand, is a white male earning over $30,000 a year. He probably lives in one of the north County industrial suburbs that form the heart of Silicon Valley, or if he's in management, he resides in one of the semi-rural exclusive hillside communities. Unless their paths cross at work, the typical engineer never meets the typical production worker.

The Jobs-Housing Imbalance

The sharply stratified nature of the workforce has had a major impact on Silicon Valley's development pattern, exacerbating transportation and housing problems. Though many of the causes of the Valley's "urban" problems are particular to the area, the same problems could occur in other, new high-tech regions.

Unlike more mature urban centers, where affluent white collar workers commute from distant suburbs to jobs downtown, in Silicon Valley the poorly paid, low-skill workers commute the greatest distance. The cause is simple. Well paid professionals, hired from Stanford University - which recruits students internationally - or from the national job market, have preferred to live in the pleasant, well-served communities of the north County, near the Stanford Industrial Park and other employment centers. As industry grew in the north County, those cities built a strong tax base, enabling them to provide good schools and reliable municipal services at a relatively low tax rate.

Production workers could not compete, in the rapidly escalating housing market, with well paid professionals, so they - as well as the unemployed and senior citizens - have gradually been pushed down the Peninsula toward San Jose. San Jose, though it houses half the County's residents, has - with the exception of IBM's south San Jose complex - only recently begun to attract high-tech firms. With few professional jobs and a weak tax base to support municipal services and education programs, San Jose attracted residents who could not afford to live elsewhere. By the mid-1970's an enormous commute pattern had developed, with production workers filling the freeways every morning and afternoon.

By 1977, the imbalance between jobs and housing became so bad that even public officials and industry leaders recognized the crisis. The shortage of housing near job centers had grown so tight that companies could not attract engineers from across the country, because housing prices and rents were among the highest in the nation, and long, slow commutes were the norm.

The County organized a series of blue-ribbon task forces to study the problem, and the Valley's largest corporations formed the Santa Clara County Manufacturing Group. Everyone agreed that there was a "jobs-housing imbalance," and a number of proposals were put forward to redress that imbalance.

Six years later, little action has been taken to implement the recommendations of the task forces. With only a slight slowdown for the recession, industrial building has continued. Housing construction has moved at a snail's pace, and proposals to squeeze more housing into the north County cities' limited underdeveloped land have been repeatedly rejected by local planners.

The city of San Jose has just approved the industrial development of the rural Coyote Valley. Located at the southern edge of San Jose, this new high-tech area could balance the flow of work traffic within the County, but it will dramatically increase the daily inward commute from adjacent counties. Workers, particularly those on the production line, are paying the price of poor planning in long commutes, overcrowded housing, and automobile-generated air pollution.

Why can't the cities of Silicon Valley solve such a widely recognized problem? To some degree, each city argues that its neighbors are largely to blame, or have the land to provide housing. Residents, especially the professionals of north County, argue that new housing - and particularly moderate cost housing designed for production or clerical workers - would lower their quality of life. If there must be congestion, many feel, better it be on the freeways than in the neighborhood.

Meanwhile, although the Manufacturing Group endorses new housing, it rejects most proposed limits on industrial expansion, even in congested areas. Companies that belong to the Manufacturing Group argue for more housing in general, but not on land they have set aside for expansion.

Over the years, therefore, Silicon Valley has become a victim of its own success. It is no longer such a pleasant place to live and work. Consequently, many large employers in the Valley have been carrying out most of their expansion outside the Valley. Very few plants have been shut down or even cut back, but many high-tech companies are growing in greener pastures.

This is the Silicon Valley overflow that communities from throughout the nation are vying for. Because of the Valley's shortage of engineers - and difficulty recruiting professionals from out of the area - firms like Intel, Hewlett-Packard, and ESL are building elsewhere. Yet in most cases, firms are retaining most of their research and headquarters operations in Silicon Valley, where the action is. Ironically, production work is leaving the Valley, not because of a shortage of production labor, but because production requires engineers.

Meanwhile, the start-up fever keeps rising. In the past two years, for instance, more than a dozen new Silicon Valley ventures have initiated production of disk drives for computers.

Silicon Valley is by far the easiest place anywhere to establish a new high-tech business. It may be difficult for a new firm to recruit engineers from elsewhere, but - especially with stock options and a promise of a free hand - they can hire away experienced people from established firms. In fact, most start-ups are initiated by experienced people at larger firms.

As other areas of the U.S. and the world move into high-tech production, Silicon Valley's importance as a headquarters and laboratory for high technology will grow. Though production workers will make up a smaller percentage of the workforce, the Bank of America predicts, "Expansion of existing facilities, construction of small plants, and the planned construction of some large plants will ensure that the production work force will increase in the next few years."

A Chemical Industry

When, in early 1982, officials discovered that industrial chemicals from Fairchild Semiconductor's south San Jose plant had polluted the local water supply, Silicon Valley community leaders were surprised. Janet Gray Hayes, at the time mayor of San Jose, told the press, "I remember thinking about the smokestacks at other industries around the country. . . . I didn't expect this problem to erupt in my own community." Since that time, there has been a general recognition, in Silicon Valley, that the electronics production industry is in fact a chemical process industry. Yet the public in would-be Silicon Valleys across the country are still told frequently that high-tech industry is clean and light.

It isn't hard to see why so many people have thought the electronics industry is clean. The products don't breathe exhaust or drip oil. The factories are modern, well landscaped, and have no smokestacks protruding above their facades. Many production steps take place in "clean rooms," where the air is filtered and production workers wear surgical gowns.

But semiconductor wafer fabrication, the etching of microscopic patterns onto five-inch disks of shiny silicon, uses some of the most lethal materials known to man. Printed circuit plating, necessary for computers and just about every other form of modern electronic equipment, generates heavy-metal wastes. Since products must be cleansed at virtually every stage of production, hydrocarbon solvents are found throughout the industry.

Though some companies have impressive health and safety programs, workers are frequently exposed to hazardous materials on the job. The Santa Clara Center for Occcupational Safety and Health (SCCOSH) has received several hundred complaints from electronics workers over the past four years. Toxic fumes are sometimes even found in clean rooms, since the purpose of the filtering is merely to protect electronic products from particulate contamination.

There are three key reasons why hazardous materials are a problem for electronics workers, even at conscientious companies. First, many of the toxic materials used by the industry have few or no acute effects at the concentrations to which workers are exposed. It is difficult to assess the impact of long-term exposure, since the industry is extremely young. That is, the industry may be sitting on a public health time bomb. In addition, since workers are exposed to many other chemicals - pesticides, food additives, cigarette smoke, etc. - it is difficult to isolate the causes of chronic health problems such as cancer.

Second, without union contracts, electronics workers have no presumption of job security. Even though present law is supposed to protect workers who file complaints over unsafe working conditions, most workers do not know how to make complaints, and many are afraid that their employers will find other reasons to fire them should they rock the boat. These employees may make confidential calls to SCCOSH's hotline, if they can find the number, but they are unlikely to pursue them in-house.

Third, high-technology industry is a competitive industry, in which companies push hard to lower production costs. Production workers are rewarded for high productivity, so many relax their personal safety precautions to speed up production. For instance, gloves are frequently effective guards against exposure to acids, but workers may take them off if they slow down production.

Electronics companies, backed by some government studies, have played down the health hazards of electronics production. Employers consider job safety activism to be a step toward unionism, so most have not been friendly to SCCOSH's work. In fact, the present administration cut off SCCOSH's Federal funding - provided through the Occupational Safety and Health Administration's New Direction's program - reportedly at the urging of Silicon Valley management.

Pollution

Companies which adequately vent hazardous fumes from work areas emit those fumes into the atmosphere. The short ventpipes found on Silicon Valley factory roofs are not visible from the ground, since local architectural regulations require they be hidden. However, some experts have suggested that taller smokestacks would disperse concentrations of pollutants.

Most firms treat their emissions in accordance with regional, state, and Federal air quality rules. Yet this may be inadequate. The Silicon Valley electronics industry pours 25 tons of solvent fumes into the atmosphere each working day. Last year the Bay Area Air Quality Management District proposed regulations that would require new air treatment equipment, but the electronics industry has opposed the rules, saying the small reduction in pollution is not worth the cost.

Many small firms reportedly discharge untreated chemicals into the Silicon Valley sewage flow, but local agencies regularly confirm that large electronics firms are pre-treating their wastes. Nevertheless, so much gold from electronics production makes its way into Palo Alto's sewage sludge that the city sells its sludge ash to a company that "mines" it for precious metals.

Pre-treatment, in fact, is a temporary solution, since it generates a sludge containing a high concentration of extremely stable heavy-metal compounds. At present, the only cost-effective means for handling such wastes is to store them on-site temporarily in underground tanks, load them in trucks, and ship them out to Class I dumpsites in Martinez or near Coalinga, where they remain hazardous indefinitely.

This process is risky. In September, 1981, for instance, a tanktruck carrying wastes from a Silicon Valley electronics firm leaked toxic fumes on Interstate 680, forcing the evacuation of more than 4,000 residents and schoolchildren in the east San Francisco Bay area community of San Ramon. A number of on-site waste storage tanks in Silicon Valley have sprung leaks, sending hazardous materials into the near-surface groundwater.

Underground Storage

In early 1982, water quality officials disclosed that toxic solvents from Fairchild Semiconductor's south San Jose facility had leaked from an underground storage tank and were contaminating the water supply. Local residents noticed an above average incidence of birth defects in the area, and they blamed the leak. The resulting explosion of press coverage destroyed the electronics industry's reputation as a clean, light industry.

Since then, the Regional Water Quality Control Board has ordered firms with underground storage tanks to test for leaks. Thus far, leaks have been found at about 70 Santa Clara County sites, mostly electronics plants, and few sites tested have come up clean. The public groundwater supply serving much of the area has not yet been polluted, since a thick layer of clay separates the polluted surface area from the aquifer.

Santa Clara County's Fire Chiefs formed a task force to develop an ordinance to prevent future leaks and spills. Not only did they find present laws and regulations inadequate for the proper control of hazardous waste storage, but they discovered that "virgin" industrial chemicals were virtually unregulated. That is, no agency supervised the underground storage of extremely hazardous liquids awaiting use in the production process.

Silicon Valley's industrial leadership, represented by four trade associations - the American Electronics Assocation, the small-firm Electronics Association of California, the Semiconductor Industry Association, and the Santa Clara County Manufacturing Group - backed the Fire Chiefs' effort, and they provided the task force with technical expertise.

Industry has objected to some of the provisions. Management says the disclosure provisions require too much paperwork. It objects to provisions which shift liability from the local jurisdictions to the companies.

But the electronics industry endorsed and lobbied for the ordinance, including the key provision that new and replacement underground tanks be backed up by some form of secondary container. This contrasts with the petroleum industry, which argued that secondary containment was a costly, unproven technology.

The Inter-Governmental Council, with representatives from cities and other public agencies, finalized the language this May, and one by one the industrial cities of Silicon Valley are adopting the measure. Labor and environmental groups that backed a strong local toxics ordinance are now backing state legislation, to impose similar standards throughout California, but industry has repeatedly stated its preference for local rules.

Why has Silicon Valley industry, which for years rejected any suggestion that it posed a threat to the environment, endorsed such a strict law? There are three major reasons. First, the Fairchild spill has been costly to the company. Direct clean-up costs will exceed $10 million, and lawsuits brought by the company's residential neighbors could easily double the expense. The cost of prevention is dwarfed by the cost of a leak.

Second, chemical handling represents a small portion of the electronics industry's costs. Chemicals are critical to production, but labor costs are the largest expense items in most companies' operations.

Third, Silicon Valley's viability as a center for high technology industry depends upon its reputation as a nice place to live. How could National Semiconductor or Apple Computer recruit a young engineer from Tennessee or New York to work in an area where the water supply may be polluted? In fact, many Silicon Valley executives, as well as engineers, are members of environmental organizations which regularly lobby for strict environmental protections. As individuals, they are in the Valley because they value its environment.

Other Costs

High tech growth can be costly in other ways. As might be expected of any booming industrial area, Silicon Valley requires significant expansion of its industrial infrastructure. The San Jose Airport needs to be expanded. Local roads and transit systems need major infusions of capital. Sewage treatment facilities in San Jose and Sunnyvale are stretched to capacity - in Sunnyvale this has already forced the imposition of one moratorium on industrial growth. Even before the high-tech pollution scare, the County voted to build new aqueducts to pump in water from California's Central Valley. The electronics industry does not use huge volumes of electrical energy, but it requires reliable sources, since one outage can wipe out a few days production of semiconductor wafers. For this reason the County Manufacturing Group has argued in favor of bringing the Diablo Canyon nuclear power plant into operation.

High-technology industry imposes costs upon law enforcement as well. This year the Santa Clara County District Attorney's office established a new, inter-agency task force to investigate high-tech crime. In fact, two types of high-tech crime have emerged, creating new problems for law enforcement.

White-collar high-tech crime involves the theft of technology, including both software and hardware design. Since the recipients of the stolen secrets are frequently foreign corporations or governments, this has involved Federal as well as local enforcement agencies.

The problem, for unsophisticated local agencies, is that the average detective doesn't even know what high-tech trade secrets are. Some companies are beginning to cooperate in investigations, but local law enforcement needs additional training and new procedures to cope with what may be an epidemic of white collar high-tech crime.

Blue-collar crime in the electronics industry is also on the increase. It shouldn't be too surprising. Low-paid personnel handle small, expensive commodities such as chips or gold wire that can be marketed easily through secondary distributors. It takes an expert to identify stolen or counterfeited chips, so again local law enforcement needs additional expertise.

Local Imperatives

High technology industry is growing rapidly, and it will continue to expand. But it cannot possibly approach the rate of growth necessary to solve America's economic development needs alone. Bill McCall, a Boston high-tech real estate developer, reportedly said recently that there are 4,500 agencies in the U.S. seeking high technology investment for their communities. He said, "Some places will get a lion's share of the development but most will get no share at all."

To attract high-tech industry, areas are establishing research centers, offering tax breaks, and promising lax regulation. The primary lesson of Silicon Valley's experience is that the electronics industry, like other sectors, imposes costs on the communities where it operates. In Silicon Valley, however, those costs are spread across a tax base of thousands of firms. But a commmunity hosting two or three electronics companies may still need toxics experts and high-tech-trained law enforcement personnel to meet the challenges of high-tech development.

Most of Silicon Valley's problems can be avoided in other high-tech boom towns, but it will take careful planning that is not yet in evidence. For instance, any community opening up a "research" park should carefully consider the income mix of the prospective workforce. Zoning, or even direct involvement in the housing market, should be designed to ensure that sufficient housing for employees will be available near the workplace. Given their experiences in Silicon Valley or Massachusetts, high-tech firms will probably welcome such a planning process.

Second, communities should review the existing umbrella of environmental regulations, and determine where the gaps are both in theory and in practice. Depending upon the local geology, measures comparable to the Silicon Valley model toxics ordinance should be in place before the factories are. (The biggest problem with the Silicon Valley measure is that all parties in the Valley agreed that it would be impractical to require that all existing tanks be dug up and replaced with double containers. Instead, the measure requires regular monitoring. If leaks are discovered, then cities can require replacement.) There should be local, regional, or state programs to monitor and dispose of hazardous atmospheric, liquid, and solid wastes.

Third, financial incentives should consider what additional infrastructure and service costs will result from industrial development. Some costs, such as expansion of electrical power, water, and transportation facilities are well recognized and relatively easy to predict. But preparing local police to combat high-tech crime is ta ask the eventual cost of which is unknown even in Silicon Valley.

Federal Policies

The Federal government, of course, establishes many policies which influence high-technology industry. The most obvious implication of the Silicon Valley experience is simple: Don't develop tax and trade policies which promote high-technology as a cure-all to our economic problems. High-technology industry, with its benefits and problems, will continue to grow with or without additional assistance from the government. But the government can influence its impact.

Primary responsibility for the environmental regulation of high technology industry will probably remain at the local or state level, but Federal oversight assists in the establishment of uniform standards nationwide. Federal agencies can not only disseminate information on the environmental experience of existing high-tech areas, but by bringing its standards for underground chemical storage up to the Silicon Valley model it can discourage localities from establishing low standards in their attempts to attract high-tech firms. (Ironically, most high-tech companies say environmental regulation is a minor factor when they consider production sites.)

As the primary sponsor of environmental research, the Federal government can also initiate and expand programs that may eventually eliminate obstacles to high-tech growth. At present, the handling - storage, transportation, and "disposal" - of solid wastes, particularly metal hydroxides, is both a significant cost and risk. Over time, research could develop ways to recycle or even avoid the generation of these waste products.

Federal policy can influence the jobs-housing imbalance by enforcing or strengthening labor laws. The real reason production workers cannot find affordable housing is that they are paid low wages. One factor preventing the formation of unions, which would bring higher pay, is the uniformly hostile approach of employers to nascent organizing drives. The Federal government cannot and should not impose unions upon the high-tech workforce, but our national history demonstrates the desirability of giving labor organizing a fair shake.

Several times each year, electronics industry executives descend upon Washington, arguing that U.S. firms need help to ensure that Japanese high-tech firms compete fairly in the world market. Ironically, many of these U.S. firms are foreign-owned or have cooperative technology or trading arrangements with their Japanese competitors. Most important, in the case of semiconductors at least, U.S. imports from the offshore subsidiaries of U.S. firms have always exceeded U.S. imports from Japan. What's good for high-technology industry may not necessarily be good for the high tech workforce or what's good for the United States.

In considering high-tech trade policies, therefore, the Federal government should consider their impact not only on industry sales and profits, but employment and wages. Employers use the threat of offshore competition - Asia's incredibly low wages

- to discourage production workers here from demanding higher pay. A careful review of foreign economic policies, including tax credits, tariff code exemptions for re-imported components, OPIC insurance, etc. may suggest changes that will prevent future plant shutdowns such as the one at Atari.

There are, in fact, a large number of local, state, and Federal policies that do or could influence the nature of the development of high-technology industry in the United States. Policy-makers, in considering those policies, must remember that high-tech development has its costs as well as benefits, and that any plans to promote high technology industry must consider how it fits into the economy as a whole.

Mr. **MacKay**. Thank you, Mr. Siegel.

We will now have a time of dialog. I will call first on Congressman Gephardt.

Mr. **Gephardt**. Thank you very much.

I thank all of you for being here today, with very, very helpful testimony.

I would like to first ask Dr. Morgan about an area that is of great importance to me, the Midwest—being from Missouri. I have been very interested in your statistics and would like to know if part of your work is involved in any kind of systematic or scientific way, talking with employers in the Midwest about their job needs now and in the future.

Is that part of what you do? Or do you just work with more general statistics?

Dr. **Morgan**. No. We have a study underway right now, Congressman, in the Kansas City metropolitan area, where we are going to employers. There are roughly 31,000 firms in the Kansas City metropolitan area; 1,760 of those employ greater than 100 people. We are going to all 1,760, the larger employers, and then a random sample of the smaller ones, to try to determine what has happened to them over the last 5 years in terms of employment loss, and what they see as the outlook for the next 5 years. This would be a so-called occupational survey. One at this scale has not been done in the metropolitan area.

The Kansas City Alliance of Business, the University of Missouri, and the University of Kansas are all cooperating with the Civic Council of Greater Kansas City in this particular study. We hope it will help us find a place to place some of the displaced workers from the auto industry and some of the other basic industries that essentially are structurally unemployed.

I mentioned in the oral testimony the industrial robots in the automobile industry. Those are being used extensively in Kansas City as they are in St. Louis.

We also have several thousand jobs lost in other industries, such as refining, the steel industry. And we do need to find some places that these older, experienced, highly skilled, highly paid workers can be retrained in alternative employment. So, that study is underway right now. Those results should be available to you this fall, and maybe at least to the committee in time for consideration of some legislation.

Mr. GEPHARDT. So, you are under contract with the Civic Council in Kansas City, and you are doing the work for them? And I take it your work product can be used by any number of agencies or institutions out there, such as the Job Corps or any kind of CETA program, or any kind of community schools or training schools—all of them could make use of that information, I take it.

Dr. MORGAN. That is true. We are not under contract to do it. I am serving as the adviser to the Alliance of Business in actually getting it done. The people who actually get paid are the University of Kansas and the University of Missouri at Kansas City.

We do have two studies under way: a high technology study and a target industries study. Those studies are being sponsored by the Civic Council of Greater Kansas City. The occupational survey I mentioned does not directly have MRI under contract. But yes, all of those will be available to groups in that area as well as in other parts of the Midwest as models of how to stimulate growth and development.

Mr. GEPHARDT. Was your occupational survey done by actually having field people go out and talk to employers?

Dr. MORGAN. Yes. We are dealing with not only the CEOs, but we are also getting to the personnel people in each of the major companies, getting the detailed information by occupation.

Mr. GEPHARDT. Are you just dealing with the major companies, or are you going to get to the smaller companies?

Dr. MORGAN. We will get to the random sample of all of those smaller than 100 employees. The 1,760 companies that employ greater than 100, we are going to all of those. That will be a 100-percent sample.

There is somewhere in the neighborhood of 29,000 to 30,000 additional companies that we will try to get somewhere between 30 and 40 percent return. The majority of companies you realize have less than 20 employees in any metropolitan area. And many times, you cannot get the principal business owner, who is also the personnel man and all of the other things, to fill out some of the questionnaires. But to the extent we can, we will try to get as many of the smaller business people participating too. We believe that offers the greatest opportunity for growth and development.

You heard from Dr. David Birch earlier in these hearings. His research has found that two-thirds of the jobs created in the last decade were by firms with less than 20 employees. We feel small business is very, very important and offers the greatest potential to replace some of the jobs lost.

Mr. GEPHARDT. How long will this study take to complete, and about how much will it cost?

Dr. MORGAN. For Kansas City, it will take about 90 to 120 days for the two universities to complete it. Because we are working with the universities, the cost is going to be about $60,000 for the Kansas City metropolitan area.

Mr. **Gephardt**. Is there any thought to do this in the State of Missouri, statewide?

Dr. **Morgan**. We have talked to the Governor's office about this particular study. We have also talked to the Community and Economic Division, and I know that they are considering to do it in other cities, but I don't think they will do it statewide. But it is possible that it could be done in Columbia, St. Louis, Springfield—the metropolitan areas.

Mr. **Gephardt**. There are two other matters I would like to pursue with you.

On page 1004 you say:

> We find that the majority of jobs created are by small firms and through the expansion of existng business and industry. An inordinate amount of State and local resources are being spent on an industrial strategy that will not produce enough jobs to replace the losses that are occurring to basic industries.

From just looking quickly at your statistics, it does look like, because of the recession or because of a structural change in the economy, or because of both, there has been a tremendous job loss in these Midwestern States.

Are you suggesting that the money could be better spent by the State and local governments to try to replace these basic industry jobs, and if so, what do you think ought to be done?

Dr. **Morgan**. We have mentioned some things in the paper related to increasing the stimulation of investment and innovation within business and industry as one possible strategy to replace jobs. Not only should Federal interventions be directed that way, but State and local initiatives should be directed that way.

We feel that a lot of time, discussion and resources are going into high technology at the expense of other strategies. We feel that most communities need to make an objective assessment of what their strengths and weaknesses really are and develop a balanced economic-development strategy.

In St. Louis, the reality is we have almost 20,000 jobs in the automobile industry that have been lost the last 5 years. If we believe that concentrating all of the economic-development resources of all the agencies in St. Louis on high technology will replace those 20,000 jobs and several thousand additional jobs lost because of the multiplier, it is really folly. There are great success stories in some regions of the country, and I have no doubt in my mind that additional research and development invested in facilities like Washington University and St. Louis University in research and development will generate jobs. But they will not generate the high number of jobs that will be needed to replace the jobs that have been lost in that community due to the structural changes in the auto industry.

We simply have to concentrate some of the resources on the so-called low tech industries. We also have to do that with investment and innovation. We believe there is a substantial amount of public facilities and capital that is severely deteriorated in the Midwest. In every major city, in every State, public facilities are in deplorable condition, whether we are talking about the Interstate Highway System or the local public school district—the public capital is also needed.

That will stimulate some additional investment; if we can put additional investment there, that will stimulate additional employment in the Midwest. That is a short-term strategy for what really is a long-term problem. But that is why we believe that any economic turnaround in the Midwest, at best, is a long-term proposition.

We are talking about severe damage the last 3 years that is going to take us 4 to 6 years to overcome. And that is very, very critical.

Mr. **Gephardt**. Thank you very much. I appreciate you all being here.

Mr. **MacKay**. Representative Boehlert.

Mr. **Boehlert**. No questions.

Mr. **MacKay**. Representative Dymally.

Mr. **Dymally**. Thank you, Mr. Chairman.

Mr. Stata, can you be more specific about some proposals that might affect employment and technology?

Mr. **Stata**. The essence of the recommendation is the recognition of a point that we just made, that each region of the country has to closely analyze what its strengths and weakness are, and then collaboratively, particularly between the university educational system and the industry of that region, come to understand where opportunities are for growth and employment, and then set about to address those needs.

In the case of Massachusetts, we found until very recent years that the educational system was largely disconnected from most everything else, certainly from industry and, for that matter, government as well. So, we had the main players, State government, industry, and education going off in unrelated and disjointed directions.

We are suggesting some kind of mechanisms that provide encouragement and support for industry and the educational system of the regions to work closely together to identify training, educational needs, research needs, economic-development opportunities, and then to bring State government also into play as a partner in that process, in terms of a matching-grants program.

We are suggesting that industry should take a leadership position in going out to the universities and to the government sectors and identifying where, in fact, opportunities exist and where resources are needed to exploit those opportunities.

Industry should go first in putting its money on the line, in financing the dire needs of our universities and then the State governments should match these industry investments. The Federal Government has to get involved here too since it has long played a role in higher education in this country, particularly as it relates to basic research and to the training of technical resources in the country. That role will not only have to be continued, but even strengthened in the future, to address the significant and serious needs we have for technical manpower. At least some part of that Government funding should be done in a more passive way in the sense of providing matching grants for bottoms-up initiatives to establish linkages between local industries and local universities.

Mr. Dymally. Thank you very much.

Dr. Morgan, do you think that the Midwest is more affected by the loss of jobs as a result of high technology?

And then, the second part of my question—you suggested that Federal help in the Midwest should be aimed at stimulating industry. What industries do you think are most appropriate for the Midwest, and how can the Federal help be directed to expedite that process?

Dr. Morgan. I think on your first question, not all of the Midwest is deemed impacted by shifts in technology. Clearly, in Kansas City, St. Louis, Detroit, and Cleveland, the automobile industry and some of the affiliated industries are the ones that are impacted the greatest by some of the shifts that are going on.

Really, all manufacturing is being impacted by shifts in technology. They are trying to apply high technology to old manufacturing processes, and you have some displacement occurring.

The Midwest economy has been impacted by other factors. Construction has been tremendously impacted by the national recession and interest rates. When we look at the cutbacks in Government, we know what has happened to the Government sector. But presently, one of the more critical problems facing the Midwest in general is what is happening to agriculture. The agriculture sector has serious problems and has been in economic distress for the past 3 years.

So, we really don't have any sector of the Midwestern economy that can pick up the current economic stress. That is why it is going to take a long-term recovery.

We believe that each community or each locality has within it some resources. In the paper I mentioned, the best opportunities are from expansion of existing business and industry. We have found in study after study in major cities throughout the country that anywhere from 70 to 80 percent of the jobs created in a locality are created from expansion of existing business and industry.

Take Kansas City as an example. We have a significant telecommunications industry. There are over 10,000 people employed in that industry out of a work force of 600,000. It is clearly on our list of high-growth and very high-growth high technology industries. That is just one area of opportunity that that community could pursue.

What we are recommending at this time, because of how strained resources are at the state and local level, is that communities really need to identify what those strengths are in each area and target the resources. You might have to use a triage model in some cities.

You cannot invest in all sectors to try to replace the problems that each community is facing with lost employment. So, we are saying identify the winners and go that way with state and local resources.

Mr. Dymally. One final question for Mr. Siegel.

Most high tech jobs now are nonunion. Is it because of the nature of the high tech industry, or is it because of the nature of the kinds of people they hire, or is it the newness of the whole situation?

Mr. **Siegel.** I think the last point you made is closest. It is a new industry. Most of the major industries which we identify with organized labor in this country were not organized when first established. The newness is represented by a very high level of mobility at all levels of the work force. When a manager or an engineer is unhappy in Silicon Valley, he goes across the street and sets up a competitive company. A production worker doesn't set up a competitive company, but may work for the competitive company.

Mr. **Dymally.** Thank you, Mr. Chairman.

Dr. **Morgan.** Mr. Chairman, I would like to add something.

We have found a lot of the high technology industry that has been shifting and moving around, especially coming from the east coast to the west coast and the Midwest, is not only nonunion, but there are several parts that are low wage. So, when there is a unionization problem and some industries have the rap of being heavily-unionized and high-wage industries, we are seeing some high tech jobs really being lower paid.

There is less production employment in some high technology industries than the basic industries, and in that less production employment, you do have some lower wage and less skilled.

Most people, when they talk about high technology—the reason I say there is no agreement on the definition—there are all of these problems with what workers are really in high technology industries. Not all of them are your highly skilled, highly paid scientists and engineers. The production component is smaller than basic industry, and also the wages for the production component are usually smaller.

And you also have, whether by design or by accident, an apparent shift to areas where there is low unionization.

Mr. **Dymally.** Thank you, Mr. Chairman.

Mr. **MacKay.** Dr. Morgan, in your presentation, you pointed out that the primary concern is that you have this tertiary service industry built up to support a primary industry which is in decline. And that sort of summarizes, I guess, our concern also about the Nation.

You talked about trying to have the Federal Government participate in a workable retraining program. And certainly that is one dimension of what we are trying to get at. What changes need to be made and what should be the Federal role in that?

It seems to me that one of the problems is right now we cannot decide what to retrain for. And in that regard, I would like to get your comments and perhaps other comments.

Do you see a need for a better data system about what jobs are available, where they are, and that sort of thing; and if so, what should be the Federal role, in that vis-a-vis the private sector role?

Dr. **Morgan.** Well, in the present Federal data role, it gets built up from each State job service to the Bureau of Labor Statistics on into Washington. Then, all of us look into those numbers and try to check them out and calibrate them and find out if they agree with what we know is going on in the local level.

The local job services do not have a complete listing of all the jobs in a given area. They will have available the skills of the people who have registered for unemployment benefits. If your benefits ran out 3 or 4 years ago because you were laid off from an assembly line, you are not in that system. So we have people that are out there unemployed that we have no information about, and there are several people lost in the system of information we have now.

In the past year, for example, Kansas City has had somewhere in the range of 58,000 to 65,000 allegedly as the official unemployment. We believe there are an additional 20,000 people unemployed, structurally, not in those official statistics. We believe the rest of this decade there will probably be an additional 20,000 people that will lose their job in that work force, because of changes in technology. So, you have almost 100,000 people out there that we have limited information about their ability. But we really don't have any information about the 600,000 that are working either in terms of what skills they have and what the occupational outlook might be.

That is why in Congressman Gephardt's question, I did point out we are doing an occupational survey. Whether that can be done on a larger than a local scale only time will tell. It is going to be a quite complicated process, and I really cannot comment as to whether we can do it much larger. Over the last 10 or 15 years, we have done similar type occupational surveys in communities, but they have been a lot smaller. It has not been anything as massive as a metropolitan area.

Whether that type of information could be made a part of a Federal intervention, I am not sure. I think in your interventions and in your support for local job services and in your support for the Bureau of Labor Statistics, I think we do need to encourage the additional development of better information about what is out there now, and also what is potential.

In our target industry studies, what we mainly looked for are industries that are showing growth, either in number of firms or growth in employment, and that is what we encourage communities then to target their resources on to try to replace some of these jobs. But it is not an easy problem, as you have heard in these hearings. And we all need better information.

Mr. STATA. Mr. Chairman, during the period of the late 1970's when high tech was booming, it turns out in many parts of the country employment growth was inhibited by a lack of people with the right education and training.

I think as far as overall employment in the country, we would have gone up several notches farther than we did had we had the resources available to grow. My own belief is we are going to soon see a boom in high technology industry and again a situation where the ability to grow as rapidly as the markets would allow will be inhibited by the lack of suitably trained people.

In this sense, there is a hierarchy of training needs within high tech that starts at the highest level with professionals, and at the lowest level with assemblers. The main distinction from the point of view of economic development is how long does it take to educate and train a viable worker.

In the case of assemblers, a person can be fully productive in a period of 90 days. In the case of technicians, at least the entry level stage, as little as 26 to 52 weeks of training would suffice, at least to get somebody started. But at the professional level we are talking about 4 to 5 to 6 years of education beyond high school, and then very often 5 years or more of experience before a person is fully productive.

We have to focus where shortages exist. Our experience in Massachusetts was that some institutions can relatively quickly adapt to changing needs. For example, the community college system is very responsive to changing its output to address changing needs. But at the professional level, we have a very long-term problem that cannot be turned around overnight. So, in good times and bad, it seems to me this is where the country has to be focused in making sure that the educational resources at the university level to deal with these long-term, human-resource development requirements are met.

There is a spill-over for the country, as I indicated occurred in Massachusetts, that in many ways cannot be unforeseen. If there is a boom in one part of the economy, it has a way of spilling over into other parts of the economy. So, that suggests that the areas where we know there is great opportunity for growth, we should make sure we don't have bottlenecks to growth.

Apart from the human resources, my belief, even now in rather difficult economic times, if our cost of capital was reduced and investments encouraged for modernization, that there is much need and much opportunity to get on with rebuilding corporate America and making many parts of our manufacturing economy more viable and competitive. But there are many industries that just cannot afford at these levels of cost of capital to make the investments in the high tech tools available to them today.

If I could just take a moment to jump back to the point brought up about unions, as a person who is very much involved in this, I would like to say why I feel industry has not been unionized.

Sure enough, it is a young industry. I think that has something to say for it. But beyond that, my perception is that the high technology industry, as a young industry, has learned a lot by the mistakes of the management of the past. And I believe that the management of the high tech industry is much more enlightened about how to handle its relationships with its employees.

I think that most of the employees of the companies of high tech firms are very satisfied with their relationships with the firms and with management's approach to resolving the problems they have.

Also, there is a lot of upward mobility in the high technology industries so that people coming in at the entry level areas of the company do have career opportunities to migrate upward into higher paying jobs. I think this provides long-term encouragement for their career development in the companies.

Mr. SIEGEL. I would like to address the issue of training and suggest that training programs as a method of adjustment are not, at least for high tech, what a lot of people would like them to be.

I want to give three examples based on our experience in Silicon Valley.

First, about 2 years ago a federally subsidized Indochinese refugee agency trained and placed about 50 Vietnamese as production workers at Atari. Early this year, about 30 of them were laid off. There is no guarantee that the particular kind of jobs which people go to, given the nature of this industry and its ability to move around, and it varies by company and by sector of the industry, that the training will lead people into jobs that are permanent.

Second, we do have in Silicon Valley an example of a plant which shut down and has had what is considered a fairly comprehensive training program for the workers being laid off. They are training people for the semiconductor industry. However, I would assume most of them are going to be taking substantial pay cuts as they shift their jobs. For the people whose mortgages depend upon that, this is a real difficulty and a major decrease in the standard of living. It may be better than no job at all, but I would not consider it a major solution to their problem.

Third, both the auto industry in our area and the canneries have been considered areas where ethnic minorities, who have not had a strong educational background, can increase their income. As those industries decline, those people can get some vocational training. It is unlikely they have the verbal and mathematical background, after 20 years in the cannery, to become electronic technicians. So, even a very good training program which is merely vocational training which does not deal with basic deficiencies and inequalities in our educational system is not going to thrust them into equally high status or skilled positions in high technology industry.

Mr. MacKay. I have one more question for you, Mr. Siegel.

You pointed out that production workers are leaving Silicon Valley for other parts of the Nation and in some cases going offshore. What effect do you think increaed automation in high tech firms will have on this trend? Do you feel that the jobs are going to move?

Mr. Siegel. In some instances, the increased automation will occur at the offshore firms.

Now, the so-called jellybean assembly plants, semiconductor firms in Asia, are automated. With a certain level of automation, some of it may come back to the United States.

I think on balance most of the predictions I have seen, and it is rather complex, is that production work, despite a lot of it moving from the Valley into other places in the United States and in Asia, will continue to grow in Silicon Valley largely because of the area's attraction to new firms.

The new companies may end up doing most of their production outside of Silicon Valley. So, automation is not the major factor. The ability of the Valley to attract new companies is the reason why production will stay in the Valley.

Mr. MacKay. Mr. Walgren.

Mr. Walgren. I am sorry I had to be absent there for part of the testimony.

Mr. Stata, you indicated that the partnerships that are helpful in this area between government, universities and the like, have to be highly focused partnerships as opposed to broad, general-purpose partnerships.

Can you develop that?

Mr. Stata. Yes, if we take the high technology industry in Massachusetts as an example, one of the early things we did as a council was to conduct surveys amongst our member firms to get a precise definition of what the work force profile was and some projection into the future as to what we expected to happen.

That was the first time that that was ever done in Massachusetts. This opened up the eyes of many people on just what industry's manpower needs were. That started a process of awakening within the educational institutions as to where they should be focusing their energies and resources. The in-depth survey of the electronic industry needs in Massachusetts has now been spread nationally by the American Electronics Association. I think we have a far clearer picture today on the supply-and-demand dynamics than ever before.

If you take the normal industry associations, that kind of information is just not generated. I think, furthermore, when it comes down to making recommendations about what to do with say State funds or Federal funds, when you are dealing with very broad bases of business interests, sometimes there is competition among those interests. As a result, you average things down to zero. Whereas, if you take a particular segment of the business, at least you can get a clear picture as to what it is that that segment needs and wants to further its interests.

As to whether you respond to it is another question. But at least you have visibility on those needs.

In this respect, American industry has not been clear enough in holding up a clear picture of their opportunities and the requirements in order to be successful. And it is my feeling, based on these experiences we have had, that once visibility is given to some of these needs, then this leads to corrective actions and responsive actions, because other institutions can now understand what they have to do to respond.

This, of course, is particularly attractive in the case of a high-growth industry where people want to take advantage of the opportunity, but they just previously didn't know how.

Also, industry is sometimes confused about its own needs and what it must do to address these needs. Once industry got a clear picture on just how serious our shortage of technical resources were, we were then able to engender a reaction to this, such as more generous support of higher education and a greater participation on the part of industry in helping to solve the problems of our technical universities.

Today, we have the so-called 2-percent solution where the high technology companies in Massachusetts are giving 2 percent of their R&D expenditures to technical universities to help them solve their problems.

We have other situations where we have piloted retraining programs to provide career bridges from areas of non-high tech to high tech. We have identified the kind of training required to enter the industry by people who traditionally wouldn't have seen the opportunities or understood how to exploit them.

Once there is clarity about the needs of a segment, then you have a chance of addressing it. That is done much better in a focused way.

Mr. **Walgren**. You also indicate that a great part of the job growth in New England was in service and government jobs. And the government jobs are reminiscent of some testimony the other day where the estimates were that government would be expanding substantially, and yet that has not, at least on the Federal level, been our experience in terms of numbers of employees.

The feeling was that we had really about topped out in our ability to carry the size of government that we have in this country, and, therefore, the question arose of whether government jobs were going to be expanding.

I was curious as to the balance between service jobs and government jobs and their growth in New England, and whether there might be a general comment you could make about that. Also, if you would perhaps give us just as a footnote in writing the detail on the growth of government jobs in New England. Because if that is where the replacement was, many of us would be doubtful that we are going to get that degree of contribution in the future.

[Material to be supplied follows:]

GOVERNMENT EMPLOYMENT TRENDS

[In percent]

	1960	1970	1980	1982
Massachusetts	13.0	14.1	15.5	14.0
United States	15.4	17.7	18.0	17.6

Mr. STATA. On that point, in the written statement submitted it shows a breakdown in 1982 of the employment in Massachusetts. For example, employment in government jobs in Massachusetts was 13.6 percent. That compared to say 23.4 percent for service jobs, 19 percent for wholesale-retail trade, and 16 percent for other. Those are the nonmanufacturing segments of the economy.

So, clear enough, I think there has been some abatement in the growth of government jobs. But in a broader context, I think if we can look at the government as part of the service industry, perhaps there has been, and will continue to be, some shifting around as to how certain kinds of services are provided between the public and private sectors. But nonetheless, it seems that there is a long-term trend that suggests that employment in the goods-producing sector of the economy has been in decline and will continue to be in decline. In fact, there are numerous opportunities for growth in the broad class of service sectors that we have to look forward to in this country as a primary basis for employment growth in the decade ahead.

Mr. WALGREN. That 13 percent would be Federal, State, and local?

Mr. STATA. That is right.

Mr. WALGREN. What would that have been in 1955 or 1960?

Mr. STATA. I don't have that data, but I certainly know—my recollection is that in the 1970's, particularly in Massachusetts, we had a very substantial expansion of the State government sector, and, sure enough, that has been slowed and even reversed. But I don't have that data here.

Mr. MACKAY. Mr. Williams.

Mr. WILLIAMS. Thank you, Mr. Chairman.

Mr. Stata, in your submitted testimony you referred to a fortuitous variety of factors that you indicate are of significant importance in explaining the success of Massachusetts. And you point to a long history of excellence in both private and public higher education.

You go on to indicate that a number of engineering and science graduates come from the region, the New England region.

I note, though, that 92 percent of MIT students, according to your data, are from out of State. What percentage of those out-of-State students are from the New England region—do you know?

Mr. STATA. The only specific number I had is for the State of Massachusetts. The number is 9 percent of the enrollments in MIT are from Massachusetts. And I made the point that 36 percent of the graduates stay in State. So, we essentially have a net gain in terms of immigration. I don't know that number with respect to other New England States relative to MIT.

Mr. WILLIAMS. Do you know if the high schools or colleges in the New England region are experiencing the same difficulty in hiring and holding math, science, and engineering professors that is being experienced by similar schools in other regions of the country?

Mr. STATA. Yes, I think the pattern is very similar to other parts of the country in that respect.

Mr. WILLIAMS. In your judgment, what would a continuation of that pattern mean to the continued success in these areas?

Mr. STATA. Well, in the long term, I think it is going to be devastating, but in the intermediate term the problem is more with our technical universities than with our high schools and elementary schools.

In the last decade, we had a 100-percent increase in the enrollments of engineering schools, and a 10-percent increase in the growth of the faculty. So, we now have horrendous student-faculty ratios. Thus, the quality of education has deteriorated.

Most tragically, we have a situation in Massachusetts and in every State in the Union where the graduates coming out of our high schools, fully qualified and well able to take on the burden and with the desire to take on the burden of engineering education, are just not able to get in. So, we have a real mismatch here which has to be corrected.

It is going to take a long time to increase the engineering education capacity of this country. There will be no quick fix to that one. But I think we have to start today if we want to see any results in 5, 6, and 7 years from now.

In the meantime, I think the only hope we have of addressing the next wave of high tech growth will be for the industry itself to become much more productive in the use of technical resources already in place through computer-aided engineering and design, through more support personnel and through continuing education to update the knowledge and skills of its engineers. That is the challenge to industry in the years ahead while we are waiting for the university system to respond to this obvious need.

In the case of the high schools, there is equal tragedy there in terms of the preparation of our young people. But if you look at it just from the point of view of economic development and job creation, I think an argument can be made that that is not a substantial bottleneck to the growth of the high technology industry today or the foreseeable future. Because, in fact, there are many more qualified high school students coming out than can get into engineering schools.

I think the immediate impact of correcting some of our science and math problems in the high schools is going to be, in fact, to create greater frustrations on the part of people coming out in larger numbers and perhaps unable to get in the engineering schools. So, I think we have to approach this thing in a phased way and take care of the most immediate and urgent problems first.

Solving the lower education problems is not going to get us very far very fast if the higher education problems are not solved first.

Mr. **Williams**. Dr. Morgan, on the House Education Committee we have heard in the recent past from a number of college and university presidents who indicate that part of their difficulty in retaining the best science, engineering, and mathematics professors is due to the fact that industry, frankly, buys them away.

First, in your judgment, is that a reasonable problem? And if it is, what do we do about it? What would the appropriate Federal role, industry's role, and State and local roles be?

Dr. **Morgan**. Well, I think there are certain occupational categories that are being bought by business and industry; but that varies, depending upon the economic climate. You can put an ad in the paper today and get several hundred computer programmers to respond—fairly highly trained computer professionals. If you did that 2 years ago, you would have to buy one, and that is a regional problem. So, it is something that moves around.

I think what the Federal role should be is to continue to stimulate the training and the development of those type of professionals as has been a Federal posture since 1958. But those programs have not consistently been funded, and they are not consistently in operation today to produce the scientific, technical, and engineering manpower that we once started to produce beginning in 1958.

I think the Federal role should be to continue those programs, give them additional support, and also strengthen the amount of money at the Federal level that goes into basic research and development.

The Federal Government is the major funder of basic research and development in this country. And if you look in terms of real dollars, there has been a gradual erosion for well over a decade. And I think we need to make sure that the Federal role is to continue to stimulate that basic R&D. Basic R&D will stimulate additional innovation in other parts of the economy and also result in additional job creation.

But with basic R&D, colleges and universities can remain competitive. In fact, those colleges and universities that have developed the business/academia partnership that one of the other witnesses has discussed, where they have a substantial amount of private sector money to provide basic R&D funds, are able to effectively compete and buy those scientists back from business and industry.

So, what we have is a real interesting dilemma in that we do have a shortage in certain occupational areas, and in some areas we have surpluses. We have what at one time was a Federal program to stimulate additional training and development that is sort of weak at this point. We have a weak amount of R&D spending on the Federal side. Those type of interventions, we believe, will strengthen and help correct this imbalance.

Mr. WILLIAMS. Mr. Siegel, would you care to comment on this concern?

Mr. SIEGEL. Yes.

While I do generally share the concern about the future of high-tech education in some particular categories, I do want to throw in a couple of caveats.

First, there are significant groups of the high tech community, particularly groups representing engineers, which will argue that management exaggerates the shortage of engineers. Basically, you have engineers who want to get paid more, and management which wants to pay them less. They are arguing over supply and demand.

It would be good to see more independent studies of exactly what the real demand is. The methodology used by the American Electronics Association is, I think, deficient. I would not deny there is a need to train more people, but I do have a next door neighbor who is a Ph. D. scientist. His project was terminated. He cannot find a job in his specialty. He may be able to get a job as a programmer.

But I think we have to more carefully examine, before we go ahead and throw money into these programs, exactly what the needs are. There is a need, but at times it is exaggerated.

The second thing is that, while I do support programs to help keep scientific and engineering professors and teachers in the field, I think we have to be concerned about skewing the whole educational system. High-tech programs, given the limited resources available for education, could deny children, even within the elementary schools, some of the basic skills. I think any program that deals with this sort of training has to look at what is happening in the educational system as a whole.

What happens to a school or university where you have certain departments getting all the money, and others which are demoralized because they cannot—they are cutting back to bare bones. So I think that has to be fit into the situation, although I do agree we need to move ahead and strengthen the engineering and science faculties.

Mr. WILIAMS. Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mr. Williams.

Thank you, gentlemen.

Mr. WALGREN. We will now call on our second panel.

Your written statements will be made part of the record.

Why don't we start with Dr. Baumann.

First, I would like to welcome Dr. Page, a personal friend of mine—the Pittsburgh area is one I highly recommend to my colleagues on the committee—and then to recognize Dr. Baumann, who is also from the Pittsburgh area.

I think it is more an indication of the depth of trouble we are in. It is good to know we have good people from Pittsburgh that are thinking about this problem.

Dr. Baumann, would you proceed?

[The biographical sketch of Dr. Bauman follows:]

DWIGHT M. BAUMANN

Dr. Baumann is a Professor of Engineering Design and Director of the Center for Entrepreneurial Development at Carnegie-Mellon University, Pittsburgh, Pennsylvania. He is also Co-Director of the Transportation Research Institute and Chairman of the Interdepartmental Program in Design at CMU.

At the Center for Entrepreneurial Development, Dr. Baumann is the Executive Director and Founder. The Center, founded in 1971, provides a non-profit revolving fund to provide technical assistance and out-of-pocket start-up costs for new businesses. The Center is one of the original innovation centers funded by the National Science Foundation for a period of five years in 1973, as an experiment in the enhancement of technological innovation.

Dr. Baumann was the president and founder of Icon Corp. in 1964, sold to United Shoe Machinery in 1970; and was a founding director of Graphic Sciences Corporation from 1967 to 1975 when it was sold to Burroughs Corporation. He is presently President and CEO, of Peoples Cab Company, a taxicab company operated in Pittsburgh and owned by CED as an urban experiment station for the purpose of conducting experiments in transportation to improve the efficiency of door-to-door passenger transportation and develop information costs, maintenance and vehicle utilization for public and private fleet operation.

His professional interests include: engineering design, computer applications, transportation, entrepreneurship, engineering ethics, and the increase of engineering inputs into the public decision making process.

Dr. Baumann holds a Sc.D. and S.M. in Mechanical Engineering from MIT, and a B.S. in Mechanical Engineering from North Dakota State University. He served on the faculty of MIT from 1958 to 1970, and has prior industrial experience at General Electric Co. and the Rocketdyne Division of Rockwell Corporation. He has been a consultant to numerous firms in product development, technology transfer, corporate acquisitions and mergers, and well as evaluation and due diligence for investment bankers and venture capitalists.

STATEMENTS OF DR. DWIGHT M. BAUMANN, HEAD OF CENTER FOR ENTREPRENEURIAL DEVELOPMENT, CARNEGIE-MELLON UNIVERSITY; DR. DAVID A. PAGE, CHAIRMAN, REGIONAL RESEARCH, INC., AND DR. STEPHEN D. NELSON, ADMINSTRATIVE OFFICER FOR S&T POLICY, AMERICAN PSYCHOLOGICAL ASSOCIATION

Dr. BAUMANN. Thank you very much.

April 11, 1983, Wall Street Journal, says that 2 years ago Westinghouse Corp. purchased around 60 robots, because they wanted to give them to anybody in the Westinghouse Corp. that would put them to use. Recently, they found that a dozen of those robots are still in crates, and that they are paying storage on storing a dozen robots.

Things are so bad in Pittsburgh that 20 percent of the robots are unemployed.

That is only the beginning.

Last week the Westinghouse Corp. closed down their advanced manufacturing technology group. Three weeks ago the United States Steel Company closed down its research facilities. Two weeks ago, the Gulf Oil Co. reorganized its research facilities, which meant they cut it to about one-third of what was remaining.

A few weeks ago, a young man from what used to be called the CETA program in the city came to see me. It is now called the Job Training Partnership Act. And he said, professor, we have been training people to dig ditches, and to shingle roofs, but what do you teach someone who already has a Ph. D. and is now CETA-eligible?

We have been looking at the possibility of setting up some special courses for people who are structurally unemployed, yet very well-qualified, and now interested in starting their own business. As a matter of fact, there is some evidence that something on the order of 40 percent of new businesses are, in fact, started by people who have lost their jobs.

So, this is not only a problem in Pittsburgh, but it is also an opportunity. And what I would like to address is the opportunity part of that.

For some 12 years, we have been experimenting at a relatively small scale with the idea of helping people start new businesses. They have all been new technology businesses. Some have been what would be called high technology. Virtually any new business must start with new technology. If you are not doing something a little bit differently than the competitor, you won't have enough momentum to make it through the start-up phase.

All new businesses have new technology, even if they are in relatively what has been called low technology areas.

What we have been doing is providing some hands-on type work with new businesses. We call ourselves an incubator. What I would like to demonstrate, or discuss a little bit, is the concept.

Many people use the word "incubator" to mean a box in which something is put. It is called an industrial park. Now, if you put chicken eggs into a box and leave them there, you get rotten eggs. To make an incubator out of it, you have to give it a little tender loving care, and you have to know what it is to be done to those eggs. They have to be turned daily and kept at the correct temperature and humidity. We have discovered one of the things that needs to be done is to take away the fright of the real estate agent. Our society has tried to make real estate a security. Thus, when a company goes bankrupt, the employees get their salaries, the IRS gets its due, and the landlord gets his rent. And after that, all the accounts payable are usually left out. Thus, the people who finance new ventures are often the trade creditors. And yet, when many public agencies attempt to help start businesses, it is like the wren house-builder, who builds the nicest wren house, stands and wrings his hands—$16 a square foot, I wonder if I am going to get some wrens? Meanwhile, over in a tree are a couple of nesting birds.

Most of what happened on Route 128 in Boston started in slum property in Cambridge. In 1963, I started a company in the same building that Mr. Stata was starting his company. It was a robotics company, Icon Corp. I was the president, one of the three founders. I did this to find out how it is done, and moved to Pittsburgh in the 1970's to find out if the process could be systemized and if one could build an incubator with some live birds.

I am suggesting now there are some mechanisms we should be using, and they are very simple ones.

In the Northeast particularly, we have a surplus of vacant public buildings. Most of them are schoolhouses. These are the kind of vacant and absolete property that Digital Equipment Co. started in, in Maynard, Mass. It was an old woolen mill in that case. But the vacant school buildings could be made available to people at low or no cost.

When you notice a couple of potential nesting birds, you simply say why don't you try the third floor of that vacant building over there.

At the next level, I suggest that there should be some out-of-pocket funds. We have been quite successful, I think, in experimenting with very small amounts of money for the out-of-pocket costs—nothing for salaries. But if someone needs a lawyer or an accountant, a telephone, a secretary, or a typewriter, we put up the money out of our nonprofit revolving fund that is now being replenished from some of the previous successes.

In my presentation, I make some other suggestions that I think would be useful: The incubator facility, the low-cost one—not the expensive one—don't frighten them with fancy wren houses. They won't come.

I have listed another possible mechanism that should be used at the State level, perhaps, but there could be some Federal assistance. Another very frightening thing that happens: Someone is laid off for the first time in his life. He no longer works at U.S. Steel Research Laboratory. That is traumatic enough. But if he tries to start his own business, or even tries to do a little consulting on the side, his unemployment benefits are cut off. Now, if he is sophisticated and been laid off before, he doesn't tell anybody about working on the side and he survives. But if he tries to be honest, he doesn't.

At the time he rents space to start a new pizza parlor or whatever he decides he could do, someone will cut off his unemployment benefits. And he might not have income for 2 more years. So I think one should continue to allow the income from unemployment benefits for someone who is actually starting a business. It would save money for the unemployment compensation pool because most people who start businesses hire others, and they would likely be coming out of the unemployment pool. I believe it would save money to actually make available a continuation of the unemployment compensation for someone starting a business.

Another area that seems to make some sense at this time results from my findings that a number of Fortune 500 companies are reacting conservatively to this whole world market thing. I found companies, including IBM and Minnesota Mining, with new technology that they are not about to introduce. They even have patent protection for some. But their protection is not good enough to cover what they consider to be the risks of introducing it into the market, only to then have the market taken away from them.

Thus, I am recommending a different kind of patent, or I would call it an innovation grant. It is spelled out in my testimony. This is for companies that improve a technology by 20-percent in some performance parameter, whether it is miles per gallon of an auto or lines of resolution for a flat screen TV, or whatever. If they make a 20-percent improvement in the state of the art, in something which is already manufactured, then they will be granted exclusive marketing rights until they recover the investment in market introduction and the risks that they are facing in terms of consumer product protection, product liability, potential recall, and other issues that they need to be concerned with when they make a step change in a product.

I am recommending that this be considered in part like a patent, but perhaps does not need to go through the entire patenting procedure. It is spelled out more in my written testimony.

Well, these are several things that should be done. I would recommend the incubator—it works. Not only does it work, it has been copied directly from our current one at Carnegie-Mellon, in Sweden, the United Kingdom, and Canada. There are a few trying to copy it in the United States. The Stevenson-Wydler Act attempted to replicate our center but, in fact, the act was perhaps too broad and covered too many things, and therefore was too frightening to the new administration in terms of continuing it and funding it.

It may have looked too much like socializing the rest of R&D. But I think there are some specific, carefully planned ways to help with the incubator function. And these are part of my recommendations.

Thank you very much.

Mr. WALGREN. Thank you very much.

[The prepared statement of Dr. Baumann follows:]

A LOCAL PROGRAM FOR ENTREPRENEURIAL DEVELOPMENT IN THE NORTHEAST REGION--TEST RESULTS AND RECOMMENDATIONS

by: Prof. Dwight M. Baumann, Director The Center for Entrepreneurial Development and Professor of Engineering Design at Carnegie-Mellon University Pittsburgh, Pa.
June 16, 1983

ABSTRACT

This recommendation presents tested methods and further suggestions for developing entrepreneurship for the Northeastern Region. Within the Region there is a strong concentration of Graduate Schools of Engineering and of Business, and thus a concentration of sources of high technology and business expertise. There is, in the region, also a surplus of venture capital, and a surplus of vacant public institutional facilities, not to mention surplus housing and surplus potential employees. The recommendation thus is to ESTABLISH INCUBATOR FACILITIES and REVOLVING FUNDS for NEW BUSINESSES. This proposal is based on successful experiments at Carnegie-Mellon University in TECHNOLOGY TRANSFER VIA ENTREPRENEURSHIP.

1 Centers for Entrepreneurship

Supply side economics is not limited to increasing the supply of money for economic development via tax reduction, or even the direct subsidization of new or small businesses as a part of welfare economics. Many of the resources needed by a beginning entrepreneur have little relationship to money. Of course the problems of the entrepreneur could often, at least hypothetically be alleviated by the availability of sufficiently large sources of funds—usually the shortage is in such non-monetary parameters as intelligence, creativity, and may include the know-how and creativity needed to overcome social, legal, and regulatory barriers. Thus also necessary, may be knowledge, wisdom, and assistance in overcoming some of the barriers that have been established within our society in order to protect something else. e.g. The value of real estate as an investment or a security as contrasted to its being at risk in financing a new venture.

I suspect that a great many of the public projects that have been undertaken by federal, state, and local authorities to provide subsidized and low interest financing for the building of industrial parks and so called "incubators" have in fact been subsidies to the building industry and gifts to the real estate fraternity but have not resulted in supplying much of anything to the new ventures. In fact the new venture often starts in a garage or basement, in some forgotten corner of a university laboratory or on slum property.

There is the popular misconception that industrialization springs forth full grown by the provision of a subsidization of new industrial real estate or industrial parks. In fact the opposite is true. The predominant industries on the Route 128 in Boston first had their homes in the low cost assortment of surplus warehouses and recycled facilities of obsolete industries operated by slum landlords and leased on a month by month basis in Cambridge. New ventures most often are not interested in or able to sign the long term leases that are required by industrial developments. (It is perhaps a sign of the response to this problem that the real estate and banking lobbies have long ago successfully proposed laws that put the commercial landlord, along with the employees, and just after the IRS in recovering debts in bankruptcy. This means that other suppliers are more at risk because of their subordinated position.) Furthermore the flexibility of changes in size of the facility are often not available in first class industrial real estate. High prices real estate cannot be left vacant waiting for the tenant to grow. The best incubator space thus is the least expensive, with the least time commitment. The issue is low cost with expandability to fit unknown growth rates.

As an example of one of these resources which could become a trigger mechanism to alleviate some of the other surpluses, within the Commonwealth of Pennsylvania, there are presently in excess of one-hundred vacant, or soon to be vacant, and thus surplus school properties. Within the next five years there will be an estimated 500 vacant properties that are fully depreciated. If these were to be used as the local share of a statewide urban and rural revitalization program, an average of ten enterprise incubator cells per facility would produce 5000 new industries in the Commonwealth of Pennsylvania. Similarly, for the remainder of the Northeast.

The phenomenon of developing "incubation spaces" for new enterprise is becoming an accepted antecedent to new enterprise, particularly where it can be related to the development of new technology. The widely touted research parks and regional industrial development activities do provide for upward mobility of new enterprises, but the evidence is strong, that the new businesses start in the lofts, basements, and garages of America.

The Northeast has numerous institutions of higher education, extensive medical and corporate research, some of which should be producing even more spin-off technology. Other capable institutions have not even begun to evidence their potential. The existing evidence is that unlike the early nineteen hundreds when industry grew up around natural resources like coal or water power, on near the birthplaces of mechanical geniuses like Henry Ford, new industry now springs up around universities.

In this discussion we take as given, the fact that small and new industries supply most of the new jobs in America. Furthermore the evidence that these jobs have a natural tendency to cluster around the sources of new technology is also taken as given. The question thus becomes--how can we have more of the same, with the least cost to society in terms of welfare economics. (Tax reductions, are also public costs.) We need the greatest public benefit, given whatever kind of economics, for the least, real public cost.

Background

The major factor of indigenous industrial growth in America has been the development of the entrepreneurial class. Historically, there has been little correlation between the entrepreneurial class and other social and economic distinctions, before the fact. Many of the greatest industrialists have started from very modest, often even impoverished, means. The primary requirement is creativity, ambition, and opportunity.

In more recent years there has been a further correlation between success and higher education, particularly where so-called high technology is involved, and there has also been increasing correlation between the availability of venture capital as well. When it comes to the venture capital development, we find that there is increasing venture capital available but the venture capital industry rarely deals with start-up situations. In the few instances when they do, they insist that the ventures be undertaken by entrepreneurs with previous experience. Left unbalanced this becomes a further mechanism that guarantees success to the already successful. The present unmet need thus becomes the development of sources of pre-venture capital.

Government has long considered it to be an important function to assist declining or aging businesses. It seems much more appropriate to assist new or embryonic businesses. Shouldn't the opportunity to succeed the first time, precede the opportunity to survive from mistake or failure.

One of the primary activities of government has been the provision of public services that are not efficiently produced otherwise. Most often government has intervened in the industrialization process by many methods, the principal form of which has been of assistance by government through tax incentive or via direct subsidy.

In the case of agriculture, the government long ago considered the importance of organized research and clinically based education, via the Land Grant Act, that produced the mechanisms for the agricultural excellence. It is clear that these developments would not have happened otherwise.

What is now and has been needed, is a mechanism for tailoring a process for new industries, the lessons from agriculture. This must be accomplished within a framework that recognizes the differences between agriculture and industry. The individual farmers do not compete directly with each other, at least they do not perceive that they do in contrast to their competition with the weather and nature.

Likewise new industries, particularly those that are based on new technology are not so much competitive with each other. They may compete with old ways of doing things and thus with large and senile industries, but in fact it is now clear that change is the answer. The structural unemployment that is now being so painfully observed in the Pittsburgh, Detroit and other Northeastern cities has convinced virtually everyone that the only alternative is innovation. (See Forbes for May 12, 1983 for an excellent discussion of the Schumpeterian vs: Keynesian philosophies).

In comparison to agriculture, all individual business establishments do compete, or think they compete directly. Thus in industry, the advisors and consultants are usually required to enter into exclusive contracts for provision of assistance and technology. This would suggest a larger number of assistance programs, so that each unit could operate within the framework of assisting only one of each kind of business, or potential business at one time. In the case of working with start-up businesses alone, this would suggest the creation of a tremendous pool of expertise. Yet organized assistance to this sector would compete very little, with other interests in the entrepreneurial process. Essentially there is at present no institutional capability for nursery and incubator care of entrepreneurship of the kind suggested herein. Contrariwise the present surplus of venture capital shows that the lack of entrepreneurs exists at present, and may even be increasing.

Furthermore most business, engineering, legal, and accounting professionals do not find it within their capability to supply large amounts of service without direct remuneration. In as much as those who would be willing, and would not be in professional conflict of interest keeping them from being involved, they could have their activities collected within the proposed CENTERS. Their self interests could be synergistic with those of entrepreneurs. In the instances where a revolving fund for local and regional company startups could be developed, these funds could be used to purchase the professional services required but not otherwise available.

In the case where the service would need to be supplied within an eleemosynary framework, the relationship to the research and educational interests of the institutions of higher education should provide some of the driving forces.

We presently have research and clinically based education in agriculture, and in medicine; but in the areas of engineering and business our society seems to be dedicated toward meeting an organized international competition with an unprepared army. As in the case of agriculture, there needs to be a mechanism for collectively learning about and combating the enemies and pests, (barriers as it were) while maintaining all of the forces of competition that make for efficiency.

By incorporating the business and engineering schools, we are thus dealing with not 50 agricultural colleges, but with five or six hundred. Actually there are already approximately that many accredited schools of engineering and graduate schools of business in the country at present. Thus, the Land Grant Program for business need not include the cost of establishment of the educational or research infrastructure. A large portion of these institutions of higher education, and certainly the strongest and most viable, are in the Northeast.

An alternative of providing opportunities to qualified but otherwise financially disadvantaged potential entrepreneurs is presently not available in an organized fashion. Most of the financial support for potential entrepreneurs, has been the disorganized provision of funds enabled by the provision of capital formation, via immediate families and or deriving from tax benefits for the wealthy that encourage them to spend some of their own and some of the taxpayers monies in the so-called high risk activities. That concept may be a good one if risks were so high that the losses were in some manner equal to the gains. Remember some of the losses accrue to the taxpayers who have somehow tacitly agreed to be partners in this activity of the rich. Meanwhile the less well to do are relegated to taking their own risks at the stock market or the State Lottery. What is needed is a mechanism that allows the possibility that the poor and middle class can get rich at a rate, and perhaps even with a probability that is at least as great as that of the rich.

Government at various levels has variously experimented with indirectly developing new jobs by means of tax policy, interest subsidy and tax relief for the development of the infrastructure of business such as building, access roads, job related training, etc. The government has had programs with various degrees of success, that subsidize and supply the "bank of last resort", on the theory that normal banks will not support a failing, or "geriatric" industry.

During recent years government has increasingly fallen into the concept that the most direct and thus the fastest method of providing jobs has been for the government to do the hiring. The fallacies of this short term viewpoint are now becoming apparent to the general public with the effect that the process is being halted via the orders of the electorate.

The more appropriate approach to producing jobs is to produce employers. More employers, means more redundancy, more innovation, and better competition in the international marketplace where the false economies of increasing the GNP by increasing the cost of production via regulations are apparent.

The production of more employers should produce more employment at a faster rate. It is well known that if large industries grow, they grow linearly. When small or new industries grow they often grow exponentially. Growth or decline of the economy is an average of the individual growths or declines of the individual parts. Thus it is better for the growth to be in the area of new enterprise. The examples of parts of Massachusetts and the Silicon Valley of California are prima facie evidence that high living costs and high taxes alone do not deter growth of jobs, if those jobs are small industries, and/or high technology.

There is thus an area of consideration that has not been recognized as yet, by either the public or the private sector which has great potential. We need to develop a mechanism for accelerating and supporting the process of "birth" of new, high technological enterprises. The business start-up is by its very nature the most fundamental process of bringing technological innovation to market. New businesses remain indigenous, because the entrepreneurs usually cannot afford to start a business and finance a move to another location or another state at the same time.

This is in direct contrast to provision of subsidies and tax benefits that also apply to large industries who may then use the monies thus saved in the Northeastern portion of their operations to finance labor intensive development in other regions. I suggest that subsidies that lubricate relocation, independent of growth, are not productive. Similarly subsidies that destroy a region to build up another are wrong. New and small businesser do not relocate. They continue where the founders happened to live when the business was started. Movement to a new location occurs in the second or third management generation of a company when people start optimizing the costs. New technology usually absorbs higher costs because of uniqueness.

1.1 OPPORTUNITY-ONE--INCUBATOR FACILITIES

The vacant school buildings, left to normal market forces, will probably be sold off at prices the public will feel is too low and/or will appear to be a bonanza to the real estate speculators. At the same time there appears to be a surplus of commercial real estate within the Northeast. We believe that the public will understand a program that produces new jobs, via producing new industries. Furthermore we propose a process that selects participants based on consideration of the potential viability and degree of innovation of the proposed venture coupled of developing a local sensitivity to the process of entrepreneurial activities, with attention to neighborhood structure and acceptability of the specific activities.

Many of the communities in the Northeast have one or more school buildings, which because of declining school population, redistricting, or reasons of obsolescence have become vacant and thus represent a problem to the respective school boards. These are also a surplus resource whose potential can be utilized by some method other than simply having them torn down and selling the land. In many cases the costs of razing the buildings may exceed the actual value of the land on which they are sited. Thus they may be even more of a problem to the local community if some productive use cannot be found for the existing buildings.

In those communities where the school buildings are becoming surplus, and which already have a surplus of other commercial, retail, residential, or institutional space, putting the surplus schools into this market, in direct competition with the available vacant real estate will serve to further depress the local market. For example, if it attracts tenants or owners from exiting facilities in the community, it may serve to increase the local blight. If the building is used to enrich particular real estate speculators, or to appear to do so, it will cause even greater public concern.

In fact, the history of the sale of school buildings shows that they have been disposed for what the public feels to be trivial sums, on the order of the price of a house, when they fondly remember the building as a huge and wonderful edifice in which they went to school. On the side of the buyers, they must of course purchase the building without assurance that the zoning and other occupancy issues can be solved, and face the uncertainties of the marketplace, interest rates, demographic factors and other contingencies. Thus the low offers.

The premise of this proposal is that the community has already paid for and fully depreciated the school facilities. In economic terms it is a public, sunk cost. The question now becomes, how can the public further its goals in developing uses for unused facilities, synergistically with its other concerns. The public now considers that the loss of population, or the lack of relative renewal and growth, in much of the Northeast is associated with the loss of attractive jobs in the Region. Which came first is not so important. The fact is that empty schools seem to forebode a discounting of the future.

We believe that the communities affected with vacant school properties would be willing to invest as long term equity, in their property in the production of local, particularly high-technology jobs.

This proposal thus is to organize the development of new, non-competing jobs in these surplus-school communities, in a manner that minimizes the effect on local real estate and that will lead to filling the other commercial vacancies in the region. In order to be non-competitive, at least so much as possible with other local interests, the development of new high-technology jobs will be the most effective. In fact high-technology is usually a synonym for new technology. New technology may always be replacing old technology, however usually there is an accompanying understanding that new must replace the old and if it doesn't happen then the industry will soon be somewhere else such as Korea, Taiwan, etc. Competition is minimized, therefore, by having new jobs and new real estate uses created, rather than direct substitution. Furthermore, some process needs to be instituted so that as these new jobs are created in the surplus schools they will later become integrated into the community in a full tax paying and job creating mode.

PROPOSAL--NUMBER ONE

> WE THUS PROPOSE that abandoned school properties be made available at the cost of maintenance and utilities only: to new, start-up companies in a manner that they can proceed to a condition where they have: either grown to the size where they can buy the school property, move to upgraded property in terms of size and utility, or have proven to be unsuccessful.

> In order to accomplish this in an orderly manner: It is proposed that the States, Metropolitan Regions, or even semi-rural areas with nearby higher educational facilities, acquire the properties and convert them into non-profit clinically affiliated facilities, in the sense of teaching hospitals or agricultural experiment stations. Furthermore: that these be attached to established public and private universities that have graduate level research and education in the fields of business and engineering. The allocation process should be based on the interest of the faculties, and the size of the present graduate student population. In order to be independent an to begin without being a financial burden on the already overcommitted budgets of the educational institutions, there should be an initial grant establishing direct operating costs of the facilities, with the proviso that the future operating costs come out of equity in the viable, new industries.

The criterion of selection of these new-enterprises is a critical function. If they are too non-competitive, in the sense of new or different, they will perhaps fail because they are ahead of the marketplace. If they are too similar to existing businesses in the same locale they will not only be criticized for being unduly subsidized, but they may also fail because there are unable to compete even with an apparent subsidy, because of their own lack of maturity and understanding of the industry and the marketplace.

Provision should be made in the enabling legislation for the requirement that the business be new, or the first in the region. Where there is duplication, the case must be made for it being new within the trade region. Secondly, provision should be made for throughput of start-ups. The period of occupancy should be limited, although there could be provision that if the companies are successful and the comparative cost and communities values warrant, then the companies may purchase the facilities and the funds be used to acquire other surplus properties for the same purpose. In the case of communities that can reasonably foresee growth of school population, perhaps because of success of the program, there should be provision for the properties to be returned to educational purposes.

1.2 OPPORTUNITY-TWO--REVOLVING FUNDS FOR STARTUP

Normally the selection of potential entrepreneurial successes is left to market forces for funding of the new enterprises. This means that the natural selection process of the wealthy, choosing to invest their tax sheltered dollars in new enterprise is the controlling mechanism of "natural" selection. The implied assumption is that the wealthy are presumably also smart enough to make this selection in behalf of the taxpayers whose funds they are in part investing. If some of the rich are either smart or lucky, then of course both they and the taxpayers still win. If they are neither smart nor lucky then all loose, but the economy gains because some funds have been recycled.

Enter a new variable, the coalition of University, industry and Government to provide the mechanism of innovation and entrepreneurship. At Carnegie-Mellon University we have been involved in a twelve year experiment with a mechanism for producing new industries by the provision of an incubator function in the form of incubation space, access to university facilities, and expertise; as well as the supplying of some of the out of pocket, start-up costs, sans direct salary to the principals. These services and facilities are supplied in the form of a loan which is to be repaid when possible into a non-profit, revolving loan fund that will continue to reinvest in new ventures in perpetuity. In each case where a new venture is a for-profit operation the embryonic firm also leaves a small percentage of its capitol stock in the revolving loan fund in order to cover the costs incurred in the losses associated with unsuccessful ventures.

During six of these past years the experiment at Carnegie-Mellon was funded by the National Science Foundation as an experiment in Public Policy. As a result Canada, U.K, Sweden and several other countries have begun Centers patterned after the experiments at C-MU. Since the NSF program was experimental in nature there has been no direct intention of NSF to continue their participation. The Center at C-MU has been the only Center to become self sufficient, albeit at a limited scale, during the lifetime of the NSF sponsorship.

At the Federal level, Congress almost unanimously enacted the Stephenson-Wydler National Innovation Act to replicate Centers, citing the on at CMU as its example. The act however had several other aspects that appeared to be direct subsidies for large industries, and thus the present budget has not funded further activities under the act. It is expected that further clarification of the distinction between startup, and pre-venture funding and the general subsidization of science and technology for the presumed benefit of American industry will reactivate some Federal interest in the innovation process.

In the experiments at Carnegie-Mellon University a wholly independent institution was chartered as an eleemosynary institution, The Center for Entrepreneurial Development Inc. The Center (CED) has an IRS 501-C-3 status and could easily be expanded to have broad representation from the state or the various regions of the state. At present projects are begun in the Pittsburgh region, but the CED is working with potential entrepreneurs in Michigan, Baltimore, Boston, and Los Angeles. Broadening the CED concept to be regional, statewide, or national would involve the development of similar, sister institutions at other universities.

The resources necessary to develop the statewide, Entrepreneurial Development Programs would require the provision of initial funding for the minimum costs incurred in taking over the payments of utilities, and minimum protective and maintenance function at whatever number of school properties would be made available by the individual school districts. The present revolving fund of the CED is limited to on the order of several hundred thousand dollars. It should be realized that this has been an experiment in public policy as well as a revolving fund. In order to provide the maximum benefits to the community, on the order of five to ten million dollars per cluster of facilities would be optimum at this time. Several different scenarios of reimbursement for the property to the community could be envisioned. The development of successful enterprises should be the primary repayment. The CED charter as a Non-Profit, educational institution is the same as an institution of Higher-Education. Its purpose to to provide clinical education and research in the methods of technology transfer via entrepreneurship, to students (primarily at advanced degree levels) in business, engineering and public affairs, and at the same time to enhance the regional viability of entrepreneurs.

As such the CED, or similar institutions could become an affiliated teaching hospital, or maternity ward, as it were for several or all of the Graduate Institutions of the Commonwealth, public or private.

The degree to which the educational status would be used for justification of the continuation of the zoning and occupancy in the school buildings would of course be subject to local concerns and the concurrence of counsel. In the long run the buildings should be converted into appropriate zoning and occupancies to conform with the local interests. Each community may have a different standard with regard to the use of the buildings. In many localities the adjoining neighbors may be happy to have any kind of occupancy to reduce vandalism. Some communities may want blue-collar jobs, others may wish to restrict the facilities to health care or white collar office space.

In short, what is being proposed is the development of an quasi-public/private agencies that would work with the institutions of higher education of the Northeast in the development of a clinical facility or facilities for providing the "maternity wards" for new enterprise. These facility could also be classed as providing pre-venture capital in the forms of facilities and technological expertise and guidance. As has been the case of the each of the prior examples in which the CED has been involved in the past ten years of its pilot period, the Centers participation would continue until the Venture Capital or Banking Institutions can or are willing to be involved in the new enterprises. In the past the sources of venture capital provided directorships of the evolving firms to take the place of the member or members of the board of directors of the fledgling firm that had previously been provided by the Center for Entrepreneurial Development.

PROPOSAL-2--REVOLVING FUNDS FOR STARTUP

> It is PROPOSED that each Center for Entrepreneurship, or each cluster of centers be funded, with a one time, revolving fund of from five to ten million dollars. Furthermore these funds may be augmented, or in some cases may be established on a bases that includes matching funds in terms of local and regional contributions from foundations and industry.

The results of the Center for Entrepreneurial Development's experiments in Pittsburgh can best be utilized by expanding its operation within the City of Pittsburgh, and the Commonwealth. The experience gained thus far would suggest that the state-wide expansion would be a function of available resources and personnel alone. The form of operation, and the recipe for action exists. Since the Charter of the present non-profit corporation is broad enough, there are possible scenarios in which the expansion involves the expansion of the activities and the board of directors to represent regional or state-wide interests. Similarly for other states and regions. The scale of operation would, as has been suggested, thus be primarily a function of budget. A plurality of centers is to be encouraged.

2 National Incentives for Development of New Technology

The present climate of accelerated international competition for market share of even advanced, high production products comes about from several factors. First the fact that the international money market no longer has a gold or even a dollar standard. This requires that persons and financial institutions with international or multi national interests of means must hedge money on the international market. Usually this results in acquiring means of production in other countries. The result is that there is no longer an American Advantage of capital availability. Fluidity of international capital means that capital can seek out low labor costs.

Technology is also no longer an American commodity. In fact one of the principal exports off our country may soon be technology. At present 40% of the graduate students in our graduate engineering programs in the U.S. are foreign nationals. Increasingly these are not staying here but going back to their homelands and taking technology with them.

The problem we have however, is that at present many large industries are not introducing new technology as fact as the Japanese. I have recently encountered several areas where I believe that major American companies like I.B.M. and Minnesota Mining have on the shelf technologies that they are not going to introduce because they don't want to bear the cost of opening the market, only to have it taken away from them by foreign competitors that can produce at lower cost. Several have told me that they will wait until the foreign concerns open the market and then they will enter defensively. This same process has long been in existence in our farm machinery manufacturers who for example would wait until some farm blacksmith came up with a new machine and sold several copies and then the large manufacturer would simply do a better job of engineering, sales and distribution and take away the market. The process now repeats itself with what we thought were our high technology industries and with international connotations. It is true not only in cameras, tv's, computers and automobiles, but the mass produced robots will also most likely be built elsewhere.

It is true in many areas, that the cost of making the first one is so much bigger than the cost of making the second one. Thus there needs to be a way to protect the investment of entering into the market.

Long ago we had a good way; it was called the patent. The things that needed to be invented were simple enough. They were simple enough to be written on a single piece of paper. The low-energy automobile—the high-mileage car—is not that simple, and most of the ideas already exist, and so there is not the piece of paper on which one can write down the contract that the developer would like to make with society in order to fulfill a commitment to provide a benefit to society and get something in return.

The concept of patents that we have been using for about 550 years is one where society gains in technology and knowledge and the developer gains in having a limited monopoly.

2.1 A Patent Concept to Protect Against Disalienation

The word "monopoly" has been a bad word, but if you go back, its cousin, the question of protecting against disalienation of the means of production is a very old one. King Ahab got into trouble trying to buy a vineyard from a next door neighbor when the laws described in Leviticus did not allow land to be sold out of the family.

The concept of disalienation of rights continues through the period of time when letters patents were granted by the Crown of England, and for many years letters patents were not available to foreigners. At other times when foreign investment of ideas and technology was requires, they were made available.

The Continental Congress convened and formed our own patent codes, but until about 1836 foreigners were not allowed to have patents. Later, there were some movements to bring foreigners who would invest, provide the technology and build a sugar plant in Philadelphia and give them such a patent.

There is an interesting precedent in the State of Ohio. Congress, in 1875, decreed that "30,000 acres of land in the new Purchase to the West of Ohio be given to James Rumsey provided he shall before the first day of May next, produce good and sufficient Evidence that by means of certain Mechanism of his invention Wrought or aided by three men only, a Boat carrying ten tons has been moved for six days in succession against the stream of the R. Ohio at the rate of 50 miles pr. da."

Last year Congressman Shamansky from Columbus Ohio conducted hearings on his H.R. 5880 dealing with a prize for the first American built auto that would make 100 miles per gallon. I testified at that time about this same method of providing incentive to mature American industries to introduce new products while protecting their market entrance costs. I would like to again suggest that an investigation of this or other similar incentive measures be undertaken. The advantage of an incentive system such as the one I am proposing is that the results are rather immediate.

I have called this concept a systems patent. Another name that describes the concept is an Innovation Grant. The period would be limited as for a Design Patent and may even be set legislatively for various classes of technology. The monopoly would not be complete because if someone came along and superseded it with better technology there could be a required cross licensing. The possible conditions would be that the innovation grantee would need to demonstrate a 20% improvement in some performance specification of any standard production item. If that was demonstrated, then the grant would be given for five years (some technologies more or less) during which the grantee would have an exclusive but licenseable monopoly. If during that time another company produced another ten percent improvement in say gas mileage, resolution of the screen etc. then an arbitration would be arranged for cross licensing of the parts of the technology supplied by each producer.

It is not so important that the ownership needs to be domestic. What needs to be domestic is the jobs. We presently have such fluid capital that the rental of capital moves across national boundaries very easily. This is not our problem. We do not need to protect sources of investment for American investors. We have plenty of them, and we have plenty of foreign investors.

The issue is jobs, and therefore the patents should be given only to people who will manufacture in the country. Furthermore I believe that this proposal would provide a mechanism that would be understandable in the international. I think people understand the concept of a patent monopoly and would be willing to address it by competing. There would not be the kind of response that tariff, or quotas would cause.

3 Incentives to Entrepreneurship among the Unemployed

3.1 The Bäsic Problem, Example Pittsburgh

The present economic crisis in the City of Pittsburgh may be deeper than that of any other major city in the nation because a greater portion of the City's population may be structurally unemployed. This term is used here to identify those who, because of the present skills which are possessed (or not possessed) in relation to the skills needed in the local economy, are not likely to be able to find employment even after the current recession has run its course and even if full employment returns. Given the additional diversification and the restructuring which will be necessary if the Pittsburgh region is to have a healthy economy, there may be substantial structural unemployment here. By way of at least partial contrast, for example, the auto industry has also been badly impacted but even now there are some signs of recovery that indicate that the problem in Detroit does not match the depth of the steel industry. It even appears now that Japanese and British steel may be a factor in U.S. automobile production.[1]

If the American auto industry stabilizes or revives, large parts of it will remain in the Detroit region. The steel industry will probably not be such a dominant foundation of the Pittsburgh regional economy even in the reduced stature in which it has some chance of surviving. The difference perhaps comes from the fact that many local plants are obsolete and thus will be rebuilt elsewhere, if at all, since the area no longer enjoys its once significant comparative advantage in the production of steel. The automotive production facilities are themselves not as physically obsolete. Even, and perhaps especially, if the auto industry is incrementally automated by increasing the use of robots to augment the present transfer machine and other automatic equipment already in use, the robots will be installed in the same buildings as are presently used for making American automobiles. Furthermore the associated white collar workers who have already been affected by automation, but perhaps not as drastically reduced in number, will likely remain in charge of the automated production.

The Pittsburgh area layoffs have included various kind of white collar workers ranging from researchers, draftsmen, and procurement specialists, to accountants, and other office/clerical workers. For many if not most of these people, their old jobs are not likely to reappear in the businesses and industries that used to employ them. Presently in the city of Pittsburgh there seems to be so many structurally unemployed white collar workers as to suggest the potential of retraining them, some of whom already may have a college degree, to do something that may make them employable, particularly self employable.

We believe that there are presently several thousand white collar workers who are eligible for training under Title III, Section 302 of the Job Training Partnership Act, formerly CETA. Many members of this white collar class would not be considered under the typical approaches to retraining since past efforts have been directed at other portions of the population which were, up to the present time, thought to be the main target of the program. This new target is different. For example, these unemployed have job finding and job holding skills. Also many of these displaced white collar workers have enough basic education so that standard remedial education programs are inappropriate. Some people are college graduates or have had some college courses. This education, of course, is little comfort to those who are structurally unemployed. It is significant that if only one or two out of hundred of these structurally unemployed become succesful entrepreneurs, then the rest will likely become re-employed.

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[1] The Tuesday April 26, 1983 Post Gazette shows a decline in employment of the 20 largest Pittsburgh firms alone, from 760,308 in 1981 to 685,087 in 1982 or 75,221 employees have been separated from the companies. The article indicated that a great many of these come from the white collar staff and management sectors of the companies. The percentage of Pittsburgh based employees that were terminated was not indicated, however since the primary activity of the companies in the Pittsburgh area is the headquarters function it can be assumed that a large portion of the white collar severance occurred in the Pittsburgh district. If one includes the 16,000 Marathon employees as being located outside of Pittsburgh then an additional number of jobs are reduced in the city.

In contrast to the unemployed mill workers, this white collar population in many cases lacks the organized support often provided by labor unions, so that they do not have a natural or even environmental support system within which they can receive the kinds of assistance needed to readdress their employability. Normally they would look to higher education to alleviate their situation as they might have in the past. In this case, however, it also appears that the traditional approach of depending upon a college or university for other or more advanced degrees is it self also no longer a panacea for employment at a time when other college graduates find themselves in the same condition. While all the evidence says that education still helps, it is also true that particular kinds of education are more helpful than others. Further, the notion of seeking more advanced or even alternative degrees is not likely to be an appealing approach to many of those who are no longer in their youth.

One of the blue collar unemployed pointed out to a CED staff member recently, "I've been unemployed before and I know what to do to find a job. It's the white collar person I feel sorry for." What he probably meant was that he was confident that he could find other jobs, working with his hands as he already had and normally did during long periods of unemployment. It may be, of course, that his confidence is misplaced in this period of much higher structural unemployment in our region. However, it is likely to be true that the white collar worker does not have the background of job shifting experiences and thus faces a problem which is fundamentally different. For some portion of these, the mere fact of having had to face the experience of forced unemployment may make them less willing to have to depend upon a corporation or someone else's business -- as opposed to themselves — for their livelihood.

An often quoted statistic states that in the U.S. some 40% of new businesses are begun when the founders have become unemployed.[2] This number is, of course, relatively small in relation to the number of persons employed in the economy. However, it is said that new and small companies have the most rapid rate of growth on the average, and thus have the potential of providing the largest increase in employment in the long run. Most significant for this case, the number of those who become self employed is large in terms of the number of entrepreneurs. It may be that this natural process can be enhanced by a specific procedure to increase the number and quality of entrepreneurs from among the structurally unemployed.

While 40% of all new entrepreneurs may come from the ranks of the unemployed, the major issue is to determine whether we might be able to increase the potential of those who are both unemployed and who want to become become entrepreneurs. If only a small percentage of the unemployed become successful entrepreneurs and hire a portion of those remaining unemployed, then a significant contribution might be made to the problem of structural unemployment which is, and will continue to be, one of the most significant problems of the Pittsburgh region.

In summary, the Pittsburgh region, which now faces high unemployment, is likely to find that the ending of the recession will leave it a rate of unemployment that is still high. A large portion of our population will be structurally unemployed in the sense that, despite their skills and work experience, changes in the basic economy will have caused their jobs to vanish permanently rather than temporarily going away as has been the case in past recessions. For many reasons not especially relevant here, the entire international economy is undergoing change and the U.S. steel industry — especially the part based here in Pittsburgh — is going to be heavily impacted. The local economy is going to need to adjust.

There are probably many solutions that will be tried and, hopefully, some of those will help. It is doubtful that we will find a panacea. What we are proposing in Pittsburgh is to try to see whether an unusual approach can make a contribution. We would like to take people who are both unemployed and who harbor a desire to start a business of their own, and give them some special training which might help increase the probability of success in their new venture. Those who are successful will hire others, and the overall result might be to help the area's problem of structural unemployment.

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[2] This statistic has been quoted enough that, while everyone seems to "know it," we have not been able to trace its origin.

3.2 Incentives via Unemployment Assistance

At the state level, we have suggested some structural changes to a hearing of the Commonwealth Appropriations Committee that was primarily concerned with the large deficits in the State Unemployment Compensation Fund. Possible Federal initiatives may be of assistance to this following concept as well.

Basically, the crisis that results from unemployment, particularly structural unemployment at the white collar level, and particularly for those who have not been unemployed before is of serious concern. As has been mentioned before, a large number of new businesses happen when the founders became unemployed. Yet the very demonstration of intent to become self-employed such as negotiating a lease on a storefront to start a pizza joint has been considered by be sufficient to curtail unemployment benefits.

Our suggestion was to continue those unemployment benefits as long as the former employee continued to be searching for a job in his profession, whether or not he/she is starting a new business. The issue at the state level concerned with the Unemployment Compensation Fund is the impact on the fund. We believe that since there is a very high probability that a new business employ others, then the affect on the Unemployment fund would be positive even if the founder of a new business continued on unemployment until the end of the potential benefits. Furthermore the long term impacts of having significantly more employers would pay off with secondary effects.

4 The Results of The Experiments In Pittsburgh

4.1 Method of Operation of C.E.D.Inc.

The method of operation that C.E.D.Inc. has evolved during its initial experimental phase is similar to the method of setting up teaching hospitals in the medical profession, and has approximately the same reasoning and operating procedures as does the relationship between universities and affiliated medical facilities. Entrepreneurship and other urban experiments can thus be undertaken with maximum commitment to the experiment and the "patient", in a consistent manner, while the activities of an individual university may change from time to time to accommodate its own requirements.

The charter of the C.E.D.Inc. is to act as the catalyst for starting businesses, especially those involving new technology, in a clinical environment, where the process of innovation or entrepreneurship can be studied and nurtured. The Center for Entrepreneurial Development Inc. is thus an institution focused on:

- Clinical studies of the entrepreneurial process;
- Technical and management assistance to budding entrepreneurs;
- An independent, not-for-profit corporation whose officers and board members may be also associated with a University, in a arrangement which limits financial liabilities and protects the University's assets;
- A not-for-profit revolving fund to finance the initial out-of-pocket costs (not for salaries of the principals), common facilities, low cost rental space, purchased access to university type services (shop, printing, stores, computers, etc.).

The C.E.D.Inc. was set up as a separate non-profit entity in much the same manner as a clinic, art studio or teaching hospital would be set up, and in the same manner in which not-for-profit urban development corporations have been established in various communities. As the teaching hospitals, the agricultural experiment stations, and community development corporations have been, C.E.D.Inc. is also established for eleemosynary, public purposes.

4.2 Prior Activities of C.E.D. Inc.

The Center for Entrepreneurial Development, Inc. (C.E.D.) is a 50l-C-3 corporation in the City of Pittsburgh that has been experimenting with the development of new methods of encouraging and increasing the number and quality of entrepreneurs in the region. For the past 12 years the C.E.D.Inc. has been both directly and indirectly involved in the startup of new low, medium, and high technology industries and service facilities in the city. Some of these are Compuguard, Vectran, Transcom Data Systems, Three Rivers Computer, Bactex, Suprex, and two companies owned by women, Peoples Travel and The Iron Clad Agreement. Of these Peoples Travel and Compuguard were also initially qualified as minority owned firms.

The developments up to the time of our last annual report are shown in Fig 1. At present there are also several second generation companies as shown in Fig 2. These second generation companies "happened" without intervention or assistance from the Center for Entrepreneurial Development. Thus the basic ingredients of the development of a cluster are the successful generation of a first generation, and then the process becomes self regenerating.

Figure 1: CED Projects as of June 1982

COMPANY	CED INVEST.	SALES	EMPLOY.	NEW CAPITAL
1. Compuguard	$40,000	$5,000,000	200	$10,000,000 tot.
(Sold 4/8/80 to Brown Boveri for $6,000,000--CED share-$90,000)				
2. Vectran	$20,000	$2,500,000	30	None
3. Transcomm	None	$8,000,000	50	$3,000,000 est.
4. Three Rivers Computer	None	$10,000,000 est.	50	$5,000,000
5. Sun Publi.	$1,000	$175,000	8	
(Closed after 11 years due other interests. No losses.)				
6. Peoples Cab	None	$350,000	50	None
7. Peoples Travel	None	$800,000	4	None
8. Iron Clad Agreement	None	$100,000	8	None
9. Jessika	$40,000	None--Out of business		
10. Bactex	$60,000	$300,000	4	N/A
11. International Lamp Co.	$1,000	Out of business--no losses		
12. Rehabilitation Equipment	None	$30.000	2	None
13. Para Comm	$25,000	None	2	None
14. Solfuel	None	None	1	
15. Taxi Accessories	$1,000	None	1pt.	
16, Road Locator	$500	None		
17. Superex Inc.	$20,000	None	3	None

From the development of the second generation of the cluster we have concluded that:

1. The process of becoming an entrepreneur is transferable from one person to another by some apprenticeship or other educational process, because the secondary development of entrepreneurs who were close observers in a previous entrepreneurial effort, resulted.

2. Clustering comes about from the fact that a successful entrepreneur has a better opportunity of being a repeat entrepreneur, then some of the clustering will come about from the several successful attempts of a good entrepreneur.

3. The case of a successful entrepreneur becoming a venture capitalist is a special case of the above, where the previous success may be repeated

Figure 2: Second Generation C.E.D. Related Companies

- Pribadi Automatrix, Inc., Monroeville, Pa. Krishnadi S. Pribadi, President (former partner in Compuguard—20 employees.)
- American Robotics Inc., Pittsburgh, Pa. Ramish Wadwani, President (former partner in Compuguard--34 employees.)
- Mindel Corporation, Monroeville, Pa.(Manufacturers of Mining Communication Equipment, 5 employees and 6 part-time.) David G. Obarski, and Mike Weretz (former Compuguard employees. and CMU)
- Advanced Mining, Inc. (Mfg. and repair of mining equipment--8 employees.) Sam Passafiume, (Former Compuguard employees. and CMU)
- American Technical Institute, Pittsburgh, Pa.(10 employees) Jerry Kokalis, President (Formerly Associate Director, CED)
- Munson's Exon Service Center (7 employees) Gilbert Conley, Partner (Former mechanic, Peoples Cab Company)
- Elcomp Systems, Inc.(10 employees) Ami Elis, President (GSIA student in the Design & Entrepreneurship course)
- New Kensington Cab Co. (8 employees) Robert Culbertson, Owner(GSIA & CIT student, Design & Entrepreneurship course)

with the second generation still controlling and guiding the first. In a sense, this model comes near to the operating methodology of our Center.

As a result we thus offer our hypotheses of clustering:

- New areas of technology, by definition offer expanding markets, and many are attracted to the potential of growth.
- Some professionals are interested in forming their own companies, and thus they plan to work for a new, small company to get the proper kind of experience. When this has been accomplished they leave to form their own firm.
- Some professionals, perhaps by accident, go to work in a small or entrepreneurial firm. Upon observation they find that they believe they are just as good or better than the owners/management, so they split to form their own firms.
- Small, new technology firms are financially unstable, thus there is also a high correlation between small, new and unemployed. This relates to the information that shows that entrepreneurs often begin a new business after sudden unemployment. Notice that the entrepreneur that moonlights

too much until he loses his job also meets the definition of being fired from his previous job. Even if he wasn't moonlighting, its hard to separate out unrest, dissatisfaction, and just plain unwillingness to be at the mercy of others. It has been pointed out that the entrepreneur often has more bosses than the employed person--thus this latter observation may be suspect.

- Some believe that the synergistic development of the infrastructure of suppliers, bankers, venture capitalists, available real estate, labor supply, etc. are the major factors in creating clustering. In fact it may well be that the infrastructure such as a suppliers network and a local venture capital source may come after there is an identifiable cluster.
- Once the clustering begins there are spin-out effects that multiply the effect rapidly. Perhaps this effect begins with the first spinout, and then when the role model becomes available to others they get the idea that they can do the same.

In conclusions we thus believe that Centers like ours can be replicated. The safest form would be the formation of a partnership relationship between ourselves and other universities attempting to form the same kind of institution. At this time there is a great deal of interest. I have been receiving so many letters of inquiry and so many telephone calls from universities, potential entrepreneurs, investors that I have not had the time, energy, or office resources to even respond with civility. Experiments such as the one at Carnegie-Mellon should be continued because the secondary impact is greater than the direct result. The second generation companies demonstrate that the concept produces virulent offspring. This is the basic proof that the companies are more than the extension of the Center for Entrepreneurial Development's, or Carnegie-Mellon's staff but rather they are genuine entrepreneurial efforts. I fully expect that the regeneration concept will continue.

The first generation companies are now generating taxes at a rate that is many times the entire NSF investment, each year. Of course it is difficult to prove that the people involved would not be employed if the Center did not exist, but it is quite clear that many of them would not have found jobs in Pittsburgh. In just one year Compuguard hired more C-MU graduates, eight, than any other employer except Ford Motor Co. and Dravo.

The original concept of the Center was also to be the urban equivalent of the Agricultural Experiment Station for investigation and direct activity in terms of improving the functions of the city. In direct analogy to the agricultural experiment station, the C.E.D.Inc. has been active in the development of experiments in urban services, the startup of new industries and even in the successful rescue of bankrupt city firms, such as People's Cab, and restoring them to productivity. In the case of the latter it also has been experimenting with new forms of shared-ride fare calculations systems, vehicle locator systems, computerized management systems, etc. However, the major focus of C.E.D. has been, and probably will continue to be, the starting of new business ventures.

There has been no one approach that has been used in our efforts to nurture new ventures. In some instances these new businesses have developed in association with a class that has been offered in the University which has been affiliated with several of the Colleges in the University. A similar approach is presently being proposed to be continued with JPTA eligible unemployed citizens of the city of Pittsburgh in courses directly offered by the C.E.D.Inc.

Historically the Center has responded, to the extent of its limited resources, to those who have come to us from the community, both academic and local citizens with ideas that were generally not fully or even well developed, for new ventures. C.E.D. has also helped some who were affiliated with the University of Pittsburgh or Carnegie-Mellon University, but not associated with the class mentioned above. The Center has also taken the initiative, itself, to interest certain persons in the development of ideas for new ventures. All of these approaches have involved individualized interaction between those in the Center and the person(s) associated with a particular new startup.

The C.E.D. Inc. has been able to draw upon the resources of several universities in the sense of being to able to contact and involve knowledgeable faculty and other experts as needed. The resources of both the University of Pittsburgh and Carnegie-Mellon University have been used on various occasions. In fact, one of the present new ventures involves the Department of Biochemistry of the University of Pittsburgh.. Another embryonic firm, now in its birth process, Suprex Inc., also involves faculty from the University of Pittsburgh. Other projects have involved persons from Duquesne, Chatham, and Carlow. This ability to involve experts wherever they exist gives the Center the capability to accommodate a wide range of potential entrepreneurs with appropriate expertise on quick notice.

4.3 Present Status of C.E.D. Inc.

The C.E.D. presently has a net worth of approximately one half million dollars which includes an estimate of the value of the stock owned by it. Since that stock is all in small closely held companies, the actual value is hard to determine. The C.E.D. presently has a cash position of in excess of $200,000 with which it is planning to find new operating space and continue its development of new businesses. In the past the C.E.D. Inc. has been able to start new companies with initial grants from the non-profit revolving fund of from $20.000 to $60,000 per company. Thus the present fund could be used to establish 3 to 5 companies, given the fact that the C.E.D. must also support its own overhead costs out of the fund. Therefore, the present plans include finding suitable building space and/or increasing the revolving fund in some manner that has the maximum potential for continuing and increasing the number of companies produced.

In the first decade of development of the C.E.D. the primary focus was on developing the techniques and procedures for the establishment of embryonic companies. Since C.E.D. was the first institution to try to accomplish this kind of task, there was no previous experience to draw upon. Thus, the process has itself been an experiment, pending the development of procedures and methods for increasing the number and quality of entrepreneurs. At this stage it is believed that the C.E.D. is able to expand its function to accommodate some of what appears to be the largest demand of the century for the development of new firms based on new technology.

The present companies located at the CED include Suprex Inc., a new start presently in its initial phases. The company is developing new methods of extracting flavors and coloring materials from natural products. The most commonly known application of the technique is the removal of caffeine from coffee, but other processes are still much in the development stage. If successful this type of process has significant application to the food and pharmaceutical industries and would utilize the growing potential of the Pittsburgh region to produce high technology pressure vessels, pumps, valves and fittings. The ultimate potential of the process and the resulting hardware developments could be very large and much exceed the potential of even the development of robotics in the region.

Paracomm Corporation is the embryonic producer of the computerized taxi meters developed by CED. These meters are capable of being interrogated remotely by a central computer, and can have the fare calculated in advance of the trip by the central computer to protect the customer against the cost of a circuitous trip. The meter makes shared riding practical. Several Cities have indicated that when the meters are available in commercial quantities they would become mandatory.

A security device company, not yet named, is developing a product to protect unoccupied vacation homes at low cost. An additional potential company with a robot product is being developed. Also a potential radio-direction finder that would locate vehicles in the city is being investigated. Other areas of concern are the production of machinery to remove the oil from sunflowers in a farm-based system that would provide a low cost source of diesel fuel. Tests have been run of some aspects of this process.

Additional products are still in the talking stage. In several cases the potential entrepreneurs have been identified, but the availability of space and revolving pre-venture funds would be critical to rapid development of new jobs. The twelve years experience of the CED Inc. has developed a significant flow of persons seeking help and advice. The availability of an increase in the resources of the CED in either the form of new space or increases of the revolving fund will increase the production of new companies, and thus jobs, with resources being the limitation on number.

Mr. WALGREN. Let's continue with Dr. Page.
[The biographical sketch of Dr. Page follows:]

DAVID ARTHUR PAGE

Date of Birth: 29 November 1933
Place of Birth: Norwich, New York

David A. Page received his B.S. in Management and M.S. in Economics from Rensselaer Polytechnic Institute, and a Masters Degree in Urban and Regional Planning and a Ph.D. at Harvard University.

Dr. Page is presently Chairman of Regional Research, Inc., a non-profit corporation concerned with regional economic development.

From 1970 to 1979 Dr. Page managed Page & Company, a management consulting firm. Projects conducted by Page & Company included a management and organization study for the World Bank, a management information system for the Allegheny County Mental Health and Mental Retardation Program, a financial management project for the Allegheny County Treasurer's office, and a management plan for a transportation project in Hartford, Connecticut.

For four years Dr. Page worked in the Office of Management and Budget, Executive Office of the President, Washington, D.C. His responsibilities included transportation programs, housing and urban development programs, labor and manpower training programs, education programs, the development of teaching cases, and the development of a public expenditure model (Project Overview). He participated on a task force to develop a management information system for the Executive Office of the President. This work included helping to write a task statement and to prepare a development plan for the Director of the Office of Management and Budget. He also participated in the President's Task Force on Urban Housing (Kaiser Commission), as a representative of the Office of Management and Budget.

In the Office of Management and Budget, he helped to design and develop program evaluation and planning systems for three major Federal agencies: the Department of Housing and Urban Development, the Department of Labor, and the Office of Economic Opportunity. This work included formulation and annual review of agency program and financial plans, program memoranda, and special analytical studies. He prepared, supervised, and edited a number of analytical studies of Federal programs including Federal Housing Assistance, Urban Renewal, On-the-Job Training, the United States Employment Service, Vocation Education, the Minimum Wage Law, and the Educational Program in Systematic Analysis.

Dr. Page worked for two years with the Area Planning Office, Harvard Medical School, Boston, Massachusetts. His work there included helping to formulate plans for the amalgamation of five hospitals, a study of housing, commercial, and other facilities in the area, and liaison work with the Boston Redevelopment Authority.

From 1958 to 1960 Dr. Page was a management intern with the New York Telephone Company, Albany, New York. His experience there included work and training in several departments of the company.

A First Lieutenant in the United States Army Corps of Engineers, Dr. Page received his basic officer training at Fort Belvoir, Virginia, and was a platoon leader at Ft. Devons, Massachusetts.

Mr. PAGE. Chairman Walgren, Members of Congress, thank you for allowing me to come before you to talk about technology and employment as it concerns our region.

The region, as I will be talking with you, is defined as western Pennsylvania, eastern Ohio, and West Virginia.

In the absence of new initiatives, western Pennsylvania, Ohio, West Virginia region, now has nearly 1 million unemployed workers. The regional unemployment rate is well above 16 percent—for example, 18 percent in Youngstown and 24 percent in Johnstown.

These 1 million unemployed workers will cost our Federal Treasury $20 billion in 1983 alone.

The presently depressed conditions in our tristate region need not be viewed with fear, hopelessness, or despair. General recognition of the present crisis provides an opportunity to rejuvenate our region and to catapult it into a new period of sustained economic growth. To do so, we must first ask ourselves what are the resources of our region, and how can these resources be put to productive use?

Our region has vast human, technical, and natural resources. The central issue is jobs. We must not be diverted from the central issue.

Point: More than 100 billion tons of known coal reserves underlie our region. These reserves are worth $2 trillion at today's prices. Tripling the production, transportation, and use of coal to 1 billion tons annually, a reasonable objective, would add $100 billion to the gross regional product in the next 10 years. Accomplishing this objective would generate a half-million new jobs.

A strategic regional energy plan should be prepared now for implementation at the earliest possible time.

Point: To accomplish our objective of moving the coal, our region must rebuild its crumbling transportation system. For example, no major investigation has been made in the locks and dams in this region for over 10 years. Some 16 locks and dams in our regional waterways system are 40 to 70 years old—substandard in size with the rest of the waterway system and deteriorating.

In addition, the Federal Government is proposing to sell and/or dismantle Conrail. This railroad line is our only direct means of moving coal to New England. The loss of this line would not only represent a severe setback to our regional industries, but would constitute a loss of an existing market for our coal.

Because of deteriorating bridges, more than 50 major highway routes are already restricted or closed to truck and automobile traffic. Many of these routes are vital to regional commerce.

A strategic regional transportation plan should be developed for targeting necessary improvements to be made in our locks and dams, railroads, highways, and bridges over the next 10 years.

The Conrail facility should be retained—not necessarily in its present form—and rebuilt.

Electrification of Conrail and other railroad lines with coal-produced electricity will build a demand for our coal resources; rebuilding our regional, transportation system would put thousands more people to work.

Point: Our region is out of compliance with the regulations of the 1977 Federal Clean Air Act. The Environmental Protection Agency is using its power under the act to limit economic growth. A strategic regional environmental plan should be developed to bring this region up to acceptable environmental standards.

Waste dump sites which threaten our drinking water must be cleaned up. The three rivers, which the French once called the La-Belle Riviere, should be restored to aquatic health.

Mining coal need not destroy our environment. Numerous examples exist within the region of lands restored to productive agricultural, recreational and other uses.

Moreover, the technology to burn coal more than 90 percent pollution-free already exists. The Georgetown University plant and the Bruce Mansfield plant at Shippingport are but two examples.

New technologies for coal gasification and liquification can be developed, producing a whole new generation of high technology industries. This technology was developed in Germany in the 1930's and perfected in the 1940's.

The consequence of protecting our natural resources and restoring our environment: A healthy economy and thousands more of new jobs.

Point: These issues in our region are all interstate issues. To be effectively administered, energy, transportation, and environmental quality must all be planned and implemented across State boundaries. New organizations capable of reaching across State lines to help each other must be developed to administer and finance these efforts.

Moderate user fees, providing they are retained in the region for operation and maintenance costs, can be used in lieu of taxes.

An essential ingredient in our recipe for an expanding economic pie will be capital formation. This task can be accomplished using a technique known as a negotiated investment strategy.

Briefly, an agenda is developed for investment in facilities critical to the economic-development strategy. This agenda is then negotiated jointly with Federal, State, corporate, and foundation participation. Scarce government, corporate and other funds can then be used collectively to accomplish tasks none of these organizations could accomplish alone.

To implement this strategy, we propose to use strategic planning, sometimes called war-planning techniques. This means all planning efforts proceed in parallel rather than in series, so that they may be implemented simultaneously. This process helps to eliminate bottlenecks. Implementation would be swift and immediate.

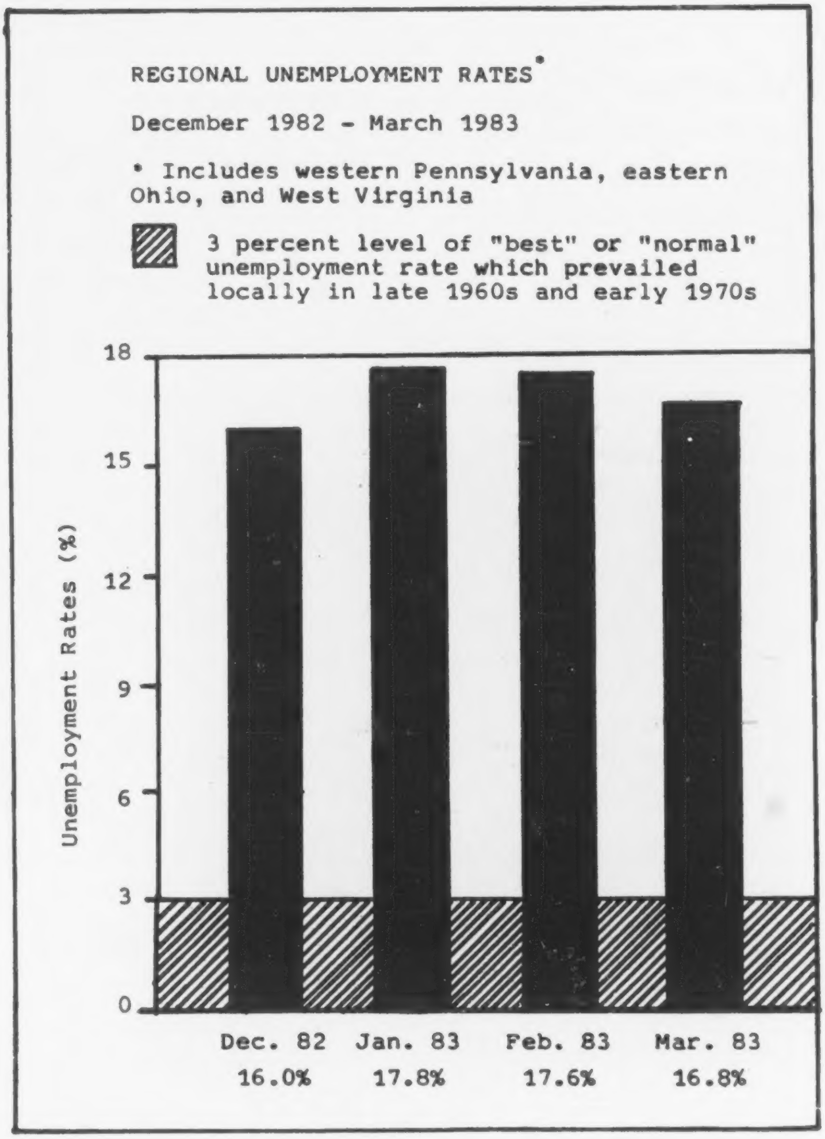
In short, this region's vast human and natural resources must be put to work to rejuvenate our region. This strategy can provide desperately needed jobs and hope.

Our region cannot live with nearly 1 million unemployed workers. Unemployment is the second largest contributor to the Federal deficit after defense spending.

The central issue is jobs. The 4-point program which I have outlined, fully implemented, would generate an estimated 1 million new jobs. It is time for our Federal, State, and local governments, corporations, foundations, and other institutions to join together in this important work.

I have some additional testimony, if I may. I would like to refer to the bar graph.

[The material follows:]



REGIONAL UNEMPLOYMENT RATES*

December 1982 - March 1983

* Includes western Pennsylvania, eastern Ohio, and West Virginia

▨ 3 percent level of "best" or "normal" unemployment rate which prevailed locally in late 1960s and early 1970s

Data Source: U.S. Bureau of Labor Statistics and state employment agencies. Compiled by Regional Research, Inc. of Pittsburgh.

Mr. PAGE. These figures are for December 1982 through March 1983. It shows the regional unemployment rate to be in the neighborhood of 16 percent.

The tristate unemployment picture is much worse than is generally understood. Using the Government's own figures which we have put together on a county-by-county basis, our research shows nearly 1 million unemployed workers in the region formed by western Pennsylvania, eastern Ohio, and West Virginia. I want to make it clear to the Members of Congress, generally speaking, this is not cyclical unemployment. Much of it will not be cured by changes in the business-cycle theory or the cyclical nature of our economy. By and large, this is structural unemployment.

Figures we have put together show 835,000 workers are now unemployed in our tristate region. Add to that the 118,000 workers who have dropped out of the labor force—some of whom may be seasonally unemployed—and we are approaching 1 million unemployed workers.

The seasonally unadjusted unemployment rate in our region was 16.8 percent, 6 percent above the unadjusted rate of 10.8 percent for the Nation. The best or more normal rate of about 3 percent was recorded the late 1960's and early 1970's.

The situation indicated by these figures is alarming. Unemployment conditions such as these have not existed since the Great Depression. Has anyone really considered what it would take to put 1 million people back to work? And has anyone seriously considered the consequences of not putting them back to work?

This situation has gone far beyond the normal business-cycle patterns, and it is not just a consequence of the economic policy of the current administration to wring inflation out of the economy. Some 20 out of 30 major steel plants in our region have now been permanently closed. Those remaining are operating at less than 50-percent capacity.

We must come to understand the situation is an emergency for our region. If this situation is not brought under control, there will be mortgage foreclosures and bankruptcies by the thousands.

What is needed here is a program for this region similar to the Marshal Plan developed for Europe in World War II. We need $10 to $12 billion in investment for this reason. Massive retraining programs will be required to put these structurally unemployed people back to work.

Thank you.

[Material submitted by Dr. Page follows:]

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1 June 1983

EXECUTIVE SUMMARY

STATE OF THE REGION: STUDY PAPER AND PROPOSAL*

Subject: A Four Point Program For Regional Economic Recovery

In the absence of new initiatives, the western Pennsylvania, Ohio, West Virginia region now has nearly one million unemployed workers. The regional unemployment rate is well above 16 percent (18 percent, for example, in Youngstown and 24 percent in Johnstown).

The presently depressed conditions in our Tri-State region need not be viewed with fear, hopelessness, or despair. General recognition of the present crisis provides an opportunity to rejuvenate our region and to catapult it into a new period of sustained economic growth.

To do so we must first ask ourselves: What are the resources of our region and how can these resources be put to productive use? Our region has vast human, technical, and natural resources.

Point I. - More than 100 billion tons of known coal reserves underlie our region. These reserves are worth $2.0 trillion at today's prices.

Tripling the production, transportation, and use of coal to one billion tons annually would add $100 billion to the gross regional product in the next ten years. Accomplishing this objective would generate half a million new jobs. A strategic regional energy plan should be prepared now for implementation at the earliest possible time.

Point II. - To accomplish our objective of moving the coal, our region must rebuild its crumbling transportation system. For example, no major investment has been made in the locks and dams in this region for over ten years. Some 16 locks and dams on our regional waterway system are 40 to 70 years old, substandard in size with the rest of the waterway system, and deteriorating.

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* - This Executive summary is a synopsis of a paper by Regional Research, Inc. entitled STATE OF THE REGION: STUDY PAPER AND PROPOSAL. Copies of this paper may be obtained by writing to David Arthur Page, Chairman, Regional Research, Inc., P.O.Box 632, Pittsburgh, PA 15230.

In addition, the federal government is proposing to sell and/or dismantle Conrail. This railroad line is our only means of moving coal to New England. The loss of this line would not only represent a severe setback to our regional industries but would constitute a loss of an existing market for our coal.

Because of deteriorating bridges, more than 50 major highway routes are already restricted or closed to truck and automobile traffic. Many of these routes are vital to regional commerce.

A strategic regional transportation plan must be developed for targeting necessary improvements to be made in our locks and dams, railroads, highways, and bridges over the next ten years. The Conrail facilities should be retained (not necessarily in its present corporate form) and rebuilt. Electrification of Conrail and other railroad lines with coal-produced electricity will build a demand for our coal resources. Rebuilding our regional transportation system would put thousands more people to work.

Point III. - Our region is out of compliance with the regulations of the 1977 federal Clean Air Act. The Environmental Protection Agency is using its powers under the Act to limit economic growth. A strategic regional environmental plan must be developed to bring this region up to acceptable environmental standards.

Waste dump sites which threaten our drinking water (e.g., Bruin Lagoon) must be cleaned up. The three rivers (which the French once called La Belle Riviere) should be restored to aquatic health.

Mining coal need not destroy our environment. Numerous examples exist within the region of lands restored to productive agriculture and other uses.

Moreover, the technology exists to burn coal more than ninety percent pollution free. The Georgetown University plant and the Bruce Mansfield plant at Shippingport are but two examples. New technologies for coal gasification and liquification can be developed, producing a whole new generation of high technology industries.

The consequence of protecting our natural resources and restoring our environment? A healthy economy and thousands more new jobs.

Point IV. - These issues are all interstate issues. To be effectively administered, energy, transportation, and environmental quality must all be planned and implemented across state boundaries. New organizations capable of reaching across state lines to help each other must be developed to administer and finance these efforts.

Moderate user fees -- providing they are retained in the region for operation and maintenance costs -- can be used in lieu of taxes.

An essential ingredient in our recipe for an expanding economic pie will be capital formation. This task can be accomplished using a technique known as a Negotiated Investment Strategy. Briefly, an agenda is developed for investment in facilities critical to the economic development strategy. This agenda is then negotiated jointly with federal, state, corporate, and foundation participation. Scarce government, corporate and other funds will then be used collectively to accomplish tasks none of these organizations could accomplish alone.

To implement this strategy, we propose to use strategic planning (sometimes called war planning) techniques. This means all planning efforts proceed in parallel, rather than in series, so they may be implemented simultaneously. This process helps to eliminate bottlenecks. Implementation will be swift and immediate.

In short, this region's vast human, technical, and natural resources must be put to work to rejuvenate our region. This strategy can provide desperately needed jobs and hope. Our region cannot live with nearly one million unemployed workers.

Our region has the potential for a new era of prolonged economic growth. It is time for our fragmented region to join together in this important work.

REGIONAL RESEARCH, INC.
P. O. BOX 632
PITTSBURGH, PENNSYLVANIA 15230
(412) 621-8760

REGIONAL UNEMPLOYMENT FIGURES[1]
(December 1982 through March 1983.)

Regional Subsection	Month	Civilian Labor Force	Number Unemployed	Unemployment Rate
Western Pa.	Dec.	1,827,200	301,800	16.5
	Jan.	1,790,200	335,800	18.7
	Feb.	1,774,400	331,700	18.7
	Mar.	1,752,500	319,600	18.2
Eastern Ohio	Dec.	2,486,062	380,095	15.3
	Jan.	2,436,303	394,668	16.2
	Feb.	2,427,799	380,588	15.7
	Mar.	2,474,191	365,797	14.8
West Va.	Dec.	778,125	132,354	17.0
	Jan.	770,200	157,500	20.4
	Feb.	760,500	159,500	21.0
	Mar.	746,500	150,100	20.1
Regional Totals[2]	Dec.	5,091,387	814,249	16.0
	Jan.	4,996,703	887,968	17.8
	Feb.	4,962,699	871,788	17.6
	Mar.	4,973,191	835,497	16.8

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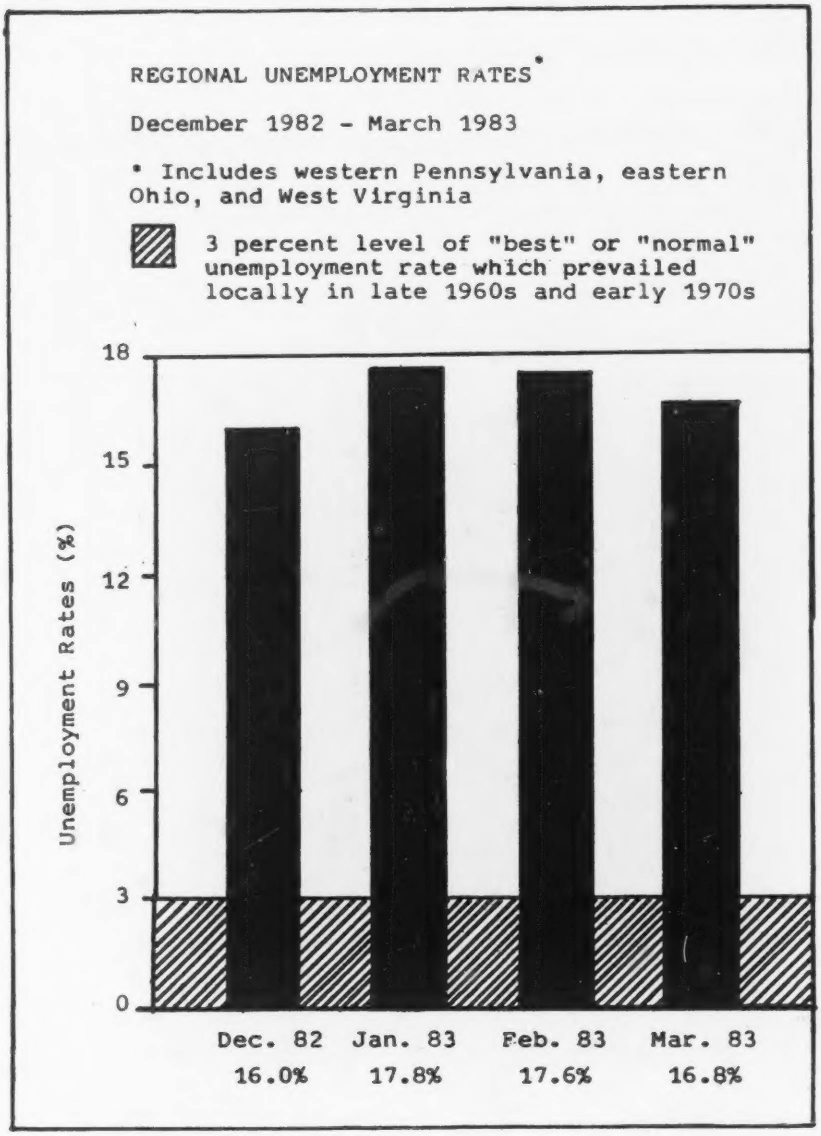
1. Sources: U.S. Bureau of Labor Statistics and State Employment Security Offices.

2. These figures were compiled from 119 contiguous counties in The Tri-state region. The unemployment figures are overstated to the extent they are not adjusted for seasonal factors. The unemployment figures are understated to the extent they do not include those who are no longer looking for work (the discouraged worker).

3. The "best" regional unemployment rate of about 3.0 percent reported 12 to 15 years ago can be contrasted with the current rate of 16.8 percent.



REGIONAL UNEMPLOYMENT RATES*

December 1982 - March 1983

* Includes western Pennsylvania, eastern Ohio, and West Virginia

▨ 3 percent level of "best" or "normal" unemployment rate which prevailed locally in late 1960s and early 1970s

Data Source: U.S. Bureau of Labor Statistics and state employment agencies. Compiled by Regional Research, Inc. of Pittsburgh.

REGIONAL UNEMPLOYMENT FIGURES*

Dec. 1982 through Mar. 1983

Western Pennsylvania, eastern Ohio, West Virginia

Month	Civilian Labor Force	Number Unemployed	Unemployment Rate
Dec.	5,091,387	814,249	16.0
Jan.	4,996,703	887,968	17.8
Feb.	4,962,699	871,788	17.6
Mar.	4,973,191	835,497	16.8

*Source: U.S. Bureau of Labor Statistics and State Unemployment Security Offices. Compiled by Regional Research, Inc. of Pittsburgh.

Background Material
Regional Research, Inc.
20 May 1983

FOUR POINT REGIONAL ECONOMIC PROGRAM

The Tri-state unemployment picture is much worse than represented by the federal government, according to an independent regional non-profit corporation. Using the governments own figures on a county-by county basis, Regional Research, Inc. totals nearly one million unemployed workers in the region formed by western Pennsylvania, eastern Ohio, and West Virginia.

The figures put together by Regional Research show 835,497 workers are now unemployed in our Tri-state region. Add to that the 118,000 workers who have dropped out of the labor force (some of whom may be seasonally unemployed) and we are approaching a million unemployed workers. See Table.

The unadjusted March unemployment rate in our region was 16.8 percent, 6.0 percent above the unadjusted rate of 10.8 percent for the Nation. The "best" or more normal rate of about 3.0 percent recorded in the late 1960s and early 1970s can be contrasted with the current rate. See Chart.

The situation indicated by these figures is alarming. Unemployment conditions such as these have not existed since the Great Depression. Has anyone seriously considered what it would take to put one million people back to work? And has anyone considered the consequences of not putting them to work?

David Arthur Page, Chairman and the Staff of Regional Research have developed a Four Point program addressing this problem. According to Page,"this situation has gone far beyond normal business cycle patterns. Nor is it just a consequence of the economic policy of the current administration to wring inflation out of the economy."

"Some 20 out of 30 major steel plants in our region have now been permanently closed," said Page. "Those remaining are operating at less than 50 percent of capacity".

"In fact, Page said, we have not had a major new steel plant in our region in about 40 years. Most of our steel plants are obsolete and can not be competitive in their present form. The loss of these plants has already shut down dozens of companies in ancillary industries."

"We must come to understand", Page emphasizes,"this situation is an emergency for our region." "If this situation is not brought under control there will be mortgage foreclosures and bankruptcies by the thousands".

"What is needed is a program for this region similar to the Marshall Plan developed for Europe after World War II." "We need $10 to $12 billion in investment for this region," Page said. "Massive retraining programs will be required to put these structurally unemployed people back to work".

Regional Research's action oriented team has come up with a hard hitting Four Point program for putting one million people back to work. Their economic development strategy goes like this.

Energy. More than 100 billion tons of known coal reserves underlie our region. These reserves are worth $2.0 trillion. Tripling the use of these resources to one billion tons annually, a reasonable objective, would add $100 billion to our gross regional product in just ten short years. It would also generate a half million new jobs.

"We have the technology on line to burn this coal and produce electricity within strict environmental guidelines", Page assures us. "Moreover, the technologies for coal liquification and coal gasification were developed in Germany in the 1930s and perfected in the 1940s."

Transportation. Sixteen locks and dams in our Tri-state region are 40 to 70 years old, substandard in size with the rest of the waterway system, and deteriorating. Because of deteriorating bridges, more than 50 truck routes are now restricted or closed. And the federal government is proposing to shut down and/or dismantle Conrail, our only direct means of getting coal to New England.

"Our crumbling regional transportation system so vital to the movement of coal and other commodities, must be rebuilt," said Page. "More than 10 years with no major investment in our locks and dams, for example, has taken its toll. Thousands of people can be proudunctively put to work rebuilding our regional transportation system."

Environment. Our region is out of compliance with the regulations of the 1977 Clean Air Act. The Environmental Protection Agency is using its powers under the Act to limit economic growth in our region. A plan and strategy should be developed to bring our region into compliance with these regulations.

Waste dump sites such as Bruin Lagoon which threaten our drinking water should be cleaned up. Environmental projects such as these are labor intensive. Launching a frontal assualt to improve our environment would produce a healthy economy and thousands more new jobs.

Administration and Finance. Because all of these issues are interstate issues, implementing this economic development strategy will require new organizations. "These organizations would reach across state boundaries to help each other", Page said.

A Negotiated Investment Strategy will be developed combining federal, state, local and foundation funds to provide the necessary capital formation collectively none of these organizations could provide individually. An Agenda for Action would be negotiated jointly with federal, state, and local governments establishing priorities for regional investment and job creation.

We think the Regional Research Four Point program merits attention and thoughtful consideration. For one thing, it focuses on the right issue -- jobs. Second, it plays to the strengths of our region's human,technical, and natural resources. Third, Page has already gotten the bipartisan support of Senators Specter, Glenn, Heinz, and Governor Rockefeller. The support of these people would be important to the successful implementation of the program.

We also think it is in the enlightened self-interest of our region's corporate community to support this program. To suggest a few reasons, our banks would help finance this effort; design, engineering, and construction firms would help to design and rebuild our locks and dams and our railroads; other corporations would supply the coal mining equipment, railroad ties, welded rails. And so on. It is time for our corporate, foundation, university, and civic leaders to get solidly behind Page's Four Point program and help translate this economic development strategy into a reality.

Mr. WALGREN. Thank you very much, Dr. Page.

Dr. Nelson.

[The biographical sketch of Dr. Nelson follows:]

CURRICULUM VITAE

Stephen Douglas Nelson

Present Position:		Administrative Officer for Science and Technology Policy American Psychological Association
Address & Telephone:	(Office)	American Psychological Association 1200 Seventeenth Street, N.W. Washington, D.C. 20036 U.S.A. (202) 833-7612
	(Home)	4031 Old Hickory Road Annandale, Virginia 22003 (703) 978-0599

EDUCATION:

Ph.D. from University of Michigan, 1971. Major area: Social Psychology. Minor areas: Psychology, Sociology. Dissertation Chair: Daniel Katz.

B.A. (Magna Cum Laude) from Kansas State University, 1965. Major in psychology. Minor in modern languages.

PROFESSIONAL EXPERIENCE:

Administration

Administrative Officer for Science and Technology Policy, American Psychology Association, 8/77 to present.

Research

Project Director, Center for Research on Utilization of Scientific Knowledge, Institute for Social Research, University of Michigan, 1/71 to 8/77.

Assistant Project Director, Center for Research on Utilization of Scientific Knowledge, Institute for Social Research, University of Michigan, 3/69 to 1/71.

Research Assistant, Department of Psychology, University of Michigan, 1/68 to 5/68.

Research Assistant, Center for Research on Learning and Teaching, University of Michigan, 5/66 to 5/67.

Teaching

Lecturer, Department of Psychology, University of Michigan, 1/75 to 8/77. Taught a graduate seminar, "The Uses of Social Science in Public Policy Issues" (offered in both Psychology and Sociology departments).

Teaching Fellow for Introductory Social Psychology, Department of Sociology, University of Michigan, 1/67 to 4/67.

DESCRIPTION OF APA POSITION:

Responsible for:

Policy analysis and development of policy options in the area of science and technology policy.
Liaison with Federal agencies, Congress, and professional associations.
Analyzing Federal policies and increasing the use of behavioral science knowledge and expertise in Federal agencies and the Congress.
Preparation of position papers, responses to agency requests for information or views, and testimony for Congressional or agency hearings.
Staff liaison with major APA committees (including preparation of agendas and briefing materials).

MEMBERSHIP IN PROFESSIONAL SOCIETIES:

American Association for the Advancement of Science
American Psychological Association
  Division 8: Personality and Social Psychology
  Division 9: Society for the Psychological Study of Social Issues
  Division 34: Population and Environmental Psychology
American Sociological Association
  Section on Environmental Sociology
  Section on Sociological Practice
Policy Studies Organization
International Association for Impact Assessment
Issues Management Association

Dr. NELSON. Thank you, Mr. Chairman.

I appreciate the opportunity to testify before this joint hearing.

Mr. Chairman and members of the committees, my name is Stephen Nelson. I am administrative officer for science and technology policy at the American Psychological Association. I am representing the over 72,000 psychologists who are members of the APA and of our sister organization, the Association for the Advancement of Psychology. I appreciate the opportunity to testify before this joint hearing on the effects of changing technologies on the Nation's work force.

Other witnesses have furnished substantive information about a number of different aspects of this issue. Many of the uncertainties, the dilemmas, the controversies, and the differences of views expressed here are based not so much on differences in goals, or perhaps even on the political means for reaching them, so much as on the relative lack of reliable, agreed-upon information—numbers, in some cases, and the assumptions underlying those numbers in others.

I would like to discuss not the problems of technology and employment themselves, but rather the sources of information about them—the information base for potential answers to the questions posed throughout these hearings.

The Nation's ability to devise solutions to the problems facing us in this arena will be no better than the quality of its information as to what is the exact nature of those problems. Careful examination of the data—and the right kinds of data—is essential if we are to understand what is really going on in these turbulent times, as distinguished from the pictures painted for us by the media.

The testimony presented thus far in these hearings provides many dramatic illustrations of popular ideas about trends in technology and employment being disconfirmed when confronted by the best data. Therefore, I would like to address this issue of the information base and the sector that provides much of that information: the social and behavioral sciences.

My testimony has two major objectives: First, to outline very briefly the central role played by social and behavioral research in trying to understand the problems related to technology and employment; and second, to suggest several specific roles for, or actions by, Government that will markedly improve the Nation's problem-solving capacity in these areas. This, in turn, should promote employment and economic growth, while moderating the disruptive effects of technolgy upon the work force and the workplace.

THE ROLE OF THE SOCIAL AND BEHAVIORAL SCIENCES IN THE NATIONAL ECONOMY

These fields are not a tiny, isolated part of the Nation's economy. Census figures show that there are roughly 250,000 social and behavioral scientists active in the United States today. This figure is roughly equivalent to the total employment in the U.S. steel industry. These scientists are employed in settings stretching across nearly all sectors and all levels of the economy. Furthermore, these fields' role in, and contributions to, the U.S. economy are well-established:

> Past investments in the social and behavioral sciences have led to, and improved, technologies of considerable dollar value. Multimillion-dollar-industries have emerged in the United States from findings and discoveries traceable to the social and behavioral sciences. A profit-oriented private economy adapts and applies these products, just as it purchases electronics or medicines which started as physical or biological science discoveries. Important enterprises are now built around economic forecasting, demographic projections, political polling and survey research, standardized educational, aptitude, and intelligence testing, personnel selection and management counseling, language instruction, psychotherapy, cost-benefit analysis, human engineering system design, consumer research, marketing analysis, symbols and image design, and information dissemination.
>
> Whole industries and professions such as advertising, public relations, and mass media audience measurement services draw continuously on information, techniques and measures developed in social and behavioral research. Technologies are also exported; for example, Gallup International. They also attract foreign investments as thousands of students come from abroad for advanced training in econometrics, linguistics, demography, survey methodology, psychometric testing, management science, et cetera. (Quoted from Larsen, 1981, p. 8.)

CENTRAL ROLE OF SOCIAL AND BEHAVIORAL SCIENCES IN ISSUES OF PRODUCTIVITY, INNOVATION, TECHNOLOGY, AND EMPLOYMENT

We believe, with the members of the subcommittee and the task force, that there is an urgent need to understand the impacts of technological change, not only in economic but also in social terms. Further, this is not just out of a sense of humanitarian concern. Technology's impacts, in turn, have powerful effects on the economic, social, and political system's ability to function effectively. These are feedback effects of the most hardnosed, bottom-line sort.

The processes of creating, deploying, adapting, using, or maintaining new technologies are not merely mechanistic nor purely economic. They are inherently social processes that depend heavily on human beings as well as machines (Tornatzky et al, 1982). As such, they have been studied by social and behavioral scientists. Drawing on this research as well as other uses made of social and behavioral research, a Government advisory group has summarized the contributions of these fields to economic productivity and innovation as being of three general types.

First, the social and behavioral sciences have been the source of decision and management tools. Examples include:

Personnel selection and assessment, used by organizations in both the public and private sectors to facilitate the fit between personal characteristics and job needs.

Survey research, used by business to make crucial investment decisions, by Government to predict future revenue and to learn about public attitudes toward policy alternatives, and by innovators to assess the market potential of new products and services.

Program evaluation research, used in many Government units at all levels from Federal to local, and also by the private sector to assess both commercial and administrative efforts.

Technology and risk assessment, intended to anticipate the full range of effects of introducing new technologies or products.

Human factors research, used extensively in the private sector for decades to adapt particular technologies or industrial proceses to the characteristics and abilities of human beings.

Econometric analysis, used heavily in both the public and private sectors.

Second, the social and behavioral sciences have been the source of social technologies. Many of the technologies that can most profoundly affect the nature and quality of employment are behavioral, social, or organizational in nature—for example, participative decisionmaking, quality control circles, gain-sharing plans—such as the Scanlon Plan or employee stock ownership plans—decentralization of organizations, and stress management programs.

And third, the social and behavioral sciences have contributed significantly to understanding the innovation process itself.

> Although seldom acknowledged, virtually all of the policy debate concerning national innovation and productivity is based on knowledge derived from social research. Some of the major contributions of social science in this field constitute a set of nonintuitive findings that have radically shifted the policy debate or changed institutional practices. (Quoted From Tornatzky et al., 1982, p 743.)

Specific examples include the following:

Changes in our understanding of what the use of a technology means, as well as recognition of the decisive role of implementation activities, have significant implications for the design of technology transfer programs, and for introducing and implementing revolutionary technological systems, for example, office automation.

Clarifying the special and essential role of small firms in productivity growth, employment, and technological innovation has shifted Federal policies toward increasing the opportunities for such contributions.

Considerable research on the management of the research and development process has led to changes both within Government and research organizations regarding the structure of research funding and indeed of organizations themselves.

Research on the adoption of energy-conserving technologies and behaviors has major implications for national energy policies and programs that have been only partially realized thus far.

Despite this record of accomplishment, the receptivity on the part of American business and the Federal Government to social and behavioral science findings and their implications has not always been great. Although such concepts were discussed and even applied on a significant scale in the 1970's, American business had not been very receptive to such concepts in the preceding two decades. As the Members of this body already know, this was in contrast to many other industrialized nations, particularly Japan, which borrowed liberally from, and adapted, social science findings regarding organizational processes and economic performance.

Similarly, the current administration has repeatedly indicated, both by explicit statement and also implicitly by other actions, that it feels that the social and behavioral sciences are of lower priority, if not altogether irrelevant, to economic recovery. At this time, these fields are effectively ignored by the administration's science advisory apparatus.

SUGGESTED ROLES FOR GOVERNMENT

Let me turn now to several specific suggestions regarding ways that Government might strengthen these fields so that the Nation as a whole can better capitalize on the resources they offer. My suggestions lie in the following areas:

Government funding of social and behavioral research.

R&D tax credits for research in this area.

Strengthening the foresight capability of the society, particularly within Government.

Science and mathematics education.

Government's role in technical assistance and as a partner to other major institutional actors.

RESEARCH FUNDING

All recent administrations have agreed that the Federal Government has a responsibility to provide stable funding for promising research in areas where there is not sufficient incentive for private sector support. The same argument can be made for State or local government support, which historically has been fairly small. The entire economy realizes significant gains from the government's continuing, and even expanding, support of social and behavioral research in such areas as human factors and ergonomics, organizational effectiveness, behavior and health, employee safety and behavior, education and training, and career and occupational choices by young people.

However, Federal support for social and behavioral research has suffered in recent years. These fields were singled out for sharply disproportionate cuts in funding by the administration in its first budgetary proposals. A relatively responsive Congress—led in large part, I might add, by the Subcommittee on Science, Research and Technology—restored part of those cuts, but the effect was still severe.

In the National Science Foundation, the cornerstone of the Federal Government's basic research support efforts, funding for the physical sciences increased approximately 60 percent from fiscal year 1980 to fiscal year 1984, using the President's proposed budget for the latter time point. By contrast, support for the social and behavioral sciences decreased 22 percent, based on the President's proposal. There has been a similar pattern in several other agencies that sponsor research in these areas.

> The continued deemphasis of social and behavioral science research is harmful for the nation's knowledge base and for its efforts to achieve economic and technological revitalization (Tornatzky, 1982, page 737).

It is essential for the economic health of the Nation that the Federal Government, and State and local governments as well, commit themselves to investments in social and behavioral research on a scale commensurate with the national and regional needs for such knowledge. The nation can no longer afford to shortchange this kind of knowledge relative to that of the other sciences.

There are some hopeful signs in this regard. The contributions of these sciences to economic productivity and the quality of employment have been recognized by several congressional committees, particularly the Subcommittee on Science Research and Technology. The subcommittee's report of last October, entitled "The Human Factor in Innovation and Productivity," contains several explicit recommendations regarding increased support for, and use of, research in these areas. In addition, this subcommittee proposed a redistribution of funds in the recent NSF authorization bill that restored the social and behavioral sciences' support in this agency to roughly fiscal year 1980 levels—an action that the House of Representatives subsequently approved.

The social and behavioral sciences are grateful for such actions. We are also confident that the wisdom of these actions will be borne out, and that the benefits—economic, social and otherwise—will far exceed the costs of such programs.

R&D TAX CREDITS

The Economic Recovery Tax Act of 1981, Public Law 97-34, provided tax credits to corporations for most kinds of new research, as a stimulus to private sector R&D that was intended then to result in increased technological innovation and productivity. However, the act explicitly excluded social research from qualifying for such tax credits. To single out this kind of valuable research for exclusion from favorable tax treatment is to create disincentives for firms to invest in this kind of research relative to other kinds, and perhaps thereby to fail to address intelligently problems of productivity, quality of work life, and so forth.

Witnesses testifying before this subcommittee in other hearings have recommended ending this discriminatory treatment. We strongly agree. Executives from numerous major U.S. firms have stated publicly the value of the social and behavioral sciences to their firms in enhancing productivity, employee satisfaction, the fit between person and job, and so forth. This artificial barrier to useful and productive research should be removed.

FORESIGHT CAPABILITY

Government at all levels should take steps to strengthen the foresight capability of major societal institutions, particularly in Government itself, in order to better anticipate future trends and to respond intelligently. This might include such measures as:

Supporting methodological research to develop further the techniques of forecasting and projections;

Strengthening governmental statistical efforts and helping to underwrite nongovernmental sources of data of general public interest. I would strongly support the recommendation made by David Birch in his testimony on the opening day of these hearings that the Federal Government should stimulate State and local governments to collect data on changes in jobs, what new skills are required, and so forth. It is important that such research efforts at different levels be coordinated;

Acquiring staff with technical training and experience in foresight efforts;

Establishing institutional requirements for attention to foresight issues on the part of all governmental agencies.

Several bills designed to strengthen the Federal Government's foresight capability either have been introduced or are in preparation. All have merits of different sorts. I am suggesting the development of a focus specifically on issues relating to technology and employment.

SCIENCE AND MATHEMATICS EDUCATION

Other witnesses have spoken in detail to this issue. We simply wish to reiterate our strong support for vigorous action on this serious problem by all relevant actors: Local school districts, teachers groups, parents groups, the business community, colleges, and universities, and government at each level from local to Federal.

In addition, however, our concern is also that there be adequate research on the best ways in which science can be taught and learned. Psychologists have made significant progress in research on this issue in recent years. One example of this progress, introduced in the Congressional Record last month by Congressman George Brown, is an article by Dr. Lauren Resnick that appeared in Science, summarizing the new consensus on the nature of learning and pointing out a number of implications for how we can improve science and math education based upon this new model.

[The material follows:]

Submitted by Dr. Stephen Nelson
American Psychological Association

Mathematics and Science Learning: A New Conception

Lauren B. Resnick

Summary. Findings in cognitive science suggest new approaches to teaching in science and mathematics.

In the last few years a new consensus on the nature of learning has begun to emerge, stimulated by research in the field that has come to be known as cognitive science. The emerging conception of learning has a direct bearing on how science and mathematics can be taught most effectively.

I will sketch here a few examples of recent findings in cognitive science, many of which support the intuition of our most thoughtful teachers. In physics and other sciences, according to these studies, even students who do well on textbook problems often cannot apply the laws and formulas they have been drilled on to interpreting actual physical events. This observation has been made on all kinds of students, including gifted middle-school children and students at some of our most prestigious universities (*1, 2*). The inability to apply routines learned in school is consistent with recent findings from the National Assessment of Educational Progress showing that mathematical problem-solving skills of American children lag far behind their calculation abilities (*3*).

Another well-supported finding is that all students, the weak as well as the strong learners, come to their first science classes with surprisingly extensive theories about how the natural world works. They use these "naive" theories to explain real world events before they have had any science instruction. Then, even after instruction in new concepts and scientifically supported theories, they still resort to their prior theories to solve any problems that vary from their textbook examples (*4–6*). Some studies have shown that students' prior theories can actually interfere with learning scientific concepts. The students' naive theories affect what they perceive to be happening in classroom demonstrations or laboratory experiments, and they continue to attach their naïve meanings to technical terms (for example, the term acceleration).

Several studies show that successful problem-solving requires a substantial amount of qualitative reasoning (*7–9*). Good problem-solvers do not rush in to apply a formula or an equation. Instead, they try to understand the problem situation; they consider alternative representations and relations among the variables. Only when they are satisfied that they understand the situation and all the variables in it in a qualitative way do they start to apply the quantification that we often mistakenly identify as the essence of "real" science or mathematics.

These demonstrations of the potent role of naïve theories in science learning, and of the central role of qualitative understanding of a situation in problem-solving, contribute to a new conception of the learner and the learning process that is emerging from cognitive research in mathematics and science. This research has in just a few years produced a new consensus on the nature of learning that is not yet widely reflected in the way mathematics and science teaching is conducted in the schools.

There are many complexities, but the fundamental view of the learner that is emerging can be expressed quite simply.

First, learners construct understanding. They do not simply mirror what they are told or what they read (*10, 11*). Learners look for meaning and will try to find regularity and order in the events of the world, even in the absence of complete information. This means that naive theories will always be constructed as part of the learning process.

Second, to understand something is to know relationships. Human knowledge

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The author is co-director of the Learning Research and Development Center and a professor of psychology at the University of Pittsburgh, Pittsburgh, Pennsylvania 15260. This article is adapted from an address at the National Convocation on Precollege Education in Mathematics and Science, National Academy of Science and National Academy of Engineering, Washington, D.C., May 1982.

is stored in clusters and organized into schemata that people use both to interpret familiar situations and to reason about new ones. Bits of information isolated from these structures are forgotten or become inaccessible to memory.

Third, all learning depends on prior knowledge. Learners try to link new information to what they already know in order to interpret the new material in terms of established schemata. This is why students interpret science demonstrations in terms of their naïve theories and why they hold onto their naïve theories for so long. The scientific theories that children are being taught in school often cannot compete as reference points for new learning because they are presented quickly and abstractly and so remain unorganized and unconnected to past experience.

What does this new understanding of the learner suggest about how we can improve mathematics and science education? First, it is never too soon to start. From their earliest years, children are developing theories about how the world works. There is reason to believe that naïve theories will not take hold so firmly if scientific theories become available to them early. Furthermore, it is becoming clear that it takes a long time, and many different examples, for understanding to develop. It is not reasonable to postpone the beginning of this process to a high school or college course.

Second, teaching has to focus on the qualitative aspects of scientific and mathematical problem situations. Too quick an advance to formulas and procedures will not help children acquire the kinds of analytical and representational skills they need. Extensive qualitative analysis is not common in science or mathematics teaching. It may seem to take too much classroom time, and many teachers are perhaps too inexperienced in these ways of thinking. But the new evidence about learning makes it clear that we cannot avoid taking on this task.

A focus on qualitative analysis and understanding of situations does not mean a retreat from the teaching of computational procedures or scientific formulas, or from the basic factual information in any discipline. There is definitely an important role for the traditional skills of mathematics and science and the facts that underlie them. But the procedures and formulas must be treated as matters that make sense, and children must be involved in the task of making sense of them. Research has not yet told us whether it is better to first become skillful at a procedure and then analyze it, or to allow procedures to grow out of understanding a situation. But research has made it clear that procedures must take on meaning and make sense or they are unlikely to be used in any situation that is at all different from the exact ones in which they were taught.

Finally, since naïve theories are inevitable, teachers will probably have to confront them directly. Students may have to be forced to pit their theories against the ones they are being asked to learn, to deal with conflict between theories in much the way that scientists do. This, too, is a new challenge, for only rarely today does teaching explicitly acknowledge children's prior theories (except to mark them wrong) or even recognize the difficult intellectual work entailed in giving them up or substantially revising them.

Research in cognitive science is not only changing our views of how people learn science and mathematics but is also shaping a theory of learning in which the content of what is learned plays a central role. In the past, it has often been difficult for mathematicians and scientists to find in the work done by psychologists and other behavioral scientists much that seemed directly relevant to the problems of teaching their disciplines. The general principles that psychologists produced seemed too far removed from the specific questions of curriculum content that concerned the scientists and mathematicians. That has changed.

A critical theme of the past several years of work in cognitive science has been that a person's intelligent performance is not a matter of disembodied "processes of thinking" but depends intimately on the kind of knowledge that the person has about the particular situation in question. This has led cognitive scientists to recognize that in order to understand complex learning they must study how people learn particular subject matters. As a result, there are now cognitive scientists actively engaged in studying mathematics learning in particular, physics learning in particular, and so forth. At the same time, mathematicians and physical and biological scientists have begun to study the cognitive processes involved in learning their disciplines, often in direct collaboration with psychologists.

This kind of collaboration has been significantly invigorated by grant programs of the National Institute of Education and the now disbanded Science Education Directorate of the National Science Foundation, but these collaborative links are still fragile. In times of retrenchment it is easy to return to traditional alliances and the familiarity of one's own discipline. To keep the collaboration alive, we must give careful attention to supporting vigorous programs of cognitive research in mathematics and science learning. If this is done, the educational payoffs are likely to be large and not unduly long in coming.

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GOVERNMENT AS A BROKER AND AS PARTNER

Dr. NELSON. Another role for Government would be to serve as a broker in facilitating the dissemination of social technologies. Central to this role would be the need to "develop institutionalized ways to identify exemplary social technologies (for example, those with a strong research base, demonstrable benefit, and replicable procedures." (Tornatzky et al., 1982, p. 742). This role is fairly rare, but there is precedent for it, for example, in some of the dissemination programs conducted in the 1970's by the Department (and earlier the Office) of Education.

In addition, this model has analogues in the case of physical technologies, such as the technology transfer programs in agencies such as NASA, NIH, et cetera. Generally, Government's role would not be an overbearing one, but rather would be as a partner willing to seek solutions to problems with other governmental levels, industry, labor, and representatives of consumers.

Some of these suggestions are more adapted to the short run, such as R&D tax incentives or the broker role. Others will have short-run payoffs but will fully realize their promise over a longer period, such as research funding and the strengthening of foresight capabilities. In all cases, however, the intent is for the Government to strengthen these vital resources, so that the Nation as a whole can make maximum use of them in addressing the critical issues posed by changes in technology for employment.

It has been a pleasure to testify before this joint hearing on these important issues. I would be happy to provide additional information or answer any questions you might have.

Thank you.

[The prepared statement of Dr. Nelson follows:]

ASSOCIATION for the ADVANCEMENT of PSYCHOLOGY

TESTIMONY OF

Stephen D. Nelson, Ph.D.

Administrative Officer for Science and Technology Policy

American Psychological Association

on behalf of

THE AMERICAN PSYCHOLOGICAL ASSOCIATION

and

THE ASSOCIATION FOR THE ADVANCEMENT OF PSYCHOLOGY

Mr. Chairman, Members of the Committees:

My name is Stephen Nelson. I am Administrative Officer for Science and Technology Policy at the American Psychological Association. I am representing the over 72,000 psychologists who are members of the APA and of our sister organization, the Association for the Advancement of Psychology. I appreciate the opportunity to testify before this joint hearing on the effects of changing technologies on the nation's work force.

Other witnesses have furnished substantive information about a number of different aspects of this issue. Many of the uncertainties, the dilemmas, the controversies, and the differences of views expressed here are based not so much on differences in goals, or perhaps even on the political means for reaching them, so much as on the relative lack of reliable, agreed-upon information -- numbers, in some cases, and the assumptions underlying those numbers in others. I would like to discuss not the problems of technology and employment themselves, but rather the sources of information about them -- the information base for potential answers to the questions posed throughout these hearings.

The nation's ability to devise solutions to the problems facing us in this arena will be no better than the quality of its information as to what is the exact nature of those problems. Careful examination of the data — and the right kinds of data — is essential if we are to understand what is really going on in these turbulent times, as distinguished from the pictures painted for us by the media. The testimony presented thus far in these hearings provides many dramatic illustrations of popular ideas about trends in technology and employment being disconfirmed when confronted by the best data. Therefore I would like to address this issue of the information base, and the sector that provides much of that information: the social and behavioral sciences.

My testimony has two major objectives: first, to outline very briefly the central role played by social and behavioral research in trying to understand the problems related to technology and employment; and second, to suggest several specific roles for, or actions by, government that will markedly improve the nation's problem-solving capacity in these areas. This in turn should promote employment and economic growth, while moderating the disruptive effects of technology upon the work force and the workplace.

The Role of the Social and Behavioral Sciences in the National Economy

These fields are not a tiny, isolated part of the nation's economy. Census figures show that there are roughly 250,000 social and behavioral scientists active in the United States today. This figure is roughly equivalent to the total employment in the U.S. steel industry. These scientists are employed in settings stretching across nearly all sectors and all levels of the economy. Furthermore, these fields' role in, and contributions to, the U.S. economy are well established:

> Past investments in the social and behavioral sciences have led to and improved technologies of considerable dollar value. Multi-million dollar industries have emerged in the United States from findings and discoveries traceable to the social and behavioral sciences. A profit-oriented private economy adapts and applies these products, just as it purchases electronics or medicines which started as physical or biological science discoveries. Important enterprises are now built around economic forecasting, demographic projections, political polling and survey research, standardized educational, aptitude, and intelligence testing, personnel selection and management counseling, language instruction, psychotherapy, cost-benefit analysis, human engineering system design, consumer research, marketing analysis, symbols and image design, and information dissemination. Whole industries and professions such as advertising, public relations, and mass media audience measurement services, draw continuously on information, techniques and measures developed in social and behavioral research. Technologies are also exported (e.g., Gallup International). They also attract foreign investments as thousands of students come from abroad for advanced training in econometrics, linguistics, demography, survey methodology, psychometric testing, management science, etc. (Larsen, 1981, p. 8).

The Central Role of the Social and Behavioral Sciences in Issues of Productivity, Innovation, Technology, and Employment

We believe, with the Members of the Subcommittee and the Task Force, that there is an urgent need to understand the impacts of technological change, not only in economic but also in social terms. Further, this is not just out of a sense of humanitarian concern. Technology's impacts in turn have powerful effects on the economic, social, and political system's ability to function effectively. These are feedback effects of the most hard-nosed, "bottom-line" sort.

The processes of creating, deploying, adapting, using, or maintaining new technologies are not merely mechanistic nor purely economic. They are inherently *social* processes that depend heavily on human beings as well as machines (Tornatzky *et al.*, 1982). As such, they have been studied by social and behavioral scientists. Drawing on this research as well as other uses made of social and behavioral reearch, a government advisory group has summarized the contributions of these fields to economic productivity and innovation as being of three general types.[1]

First, the social and behavioral sciences have been the source of *decision and management tools*. Examples include:

o Personnel selection and assessment, used by organizations in both the public and private sectors to facilitate the fit between personal characteristics and job needs.

o Survey research,"used by business to make crucial investment decisions, by government to predict future revenue and to learn about public attitudes toward policy alternatives, and by innovators to assess the market potential of new products and services" (p. 759).

o Program evaluation research, used in many government units at all levels from federal to local, and also by the private sector to assess both commercial and administrative efforts.

- Technology and risk assessment, intended to anticipate the full range of effects of introducing new technologies or products.

- Human factors research, used extensively in the private sector for decades to adapt particular technologies or industrial processes to the characteristics and abilities of human beings.

- Econometric analysis, used heavily in both the public and private sectors.

Second, the social and behavioral sciences have been the source of social technologies. Many of the technologies that can most profoundly affect the nature and quality of employment are behavioral, social, or organizational in nature -- for example, participative decision-making, quality control circles, gain-sharing plans (such as the Scanlon Plan or employee stock ownership plans), decentralization of organizations, and stress management programs.

And third, the social and behavioral sciences have contributed significantly to understanding the innovation process itself.

> Although seldom acknowledged, virtually all of the policy debate concerning national innovation and productivity is based on knowledge derived from social research . . . . Some of the major contributions of social science in this field constitute a set of nonintuitive finding that have radically shifted the policy debate or changed institutional practices (Tornatzky et al., 1982, p. 743).

Specific examples include the following:

o Changes in our understanding of what the "use" of a technology means, as well as recognition of the decisive role of implementation activities, have significant implications for the design of technology transfer programs and for introducing and implementing revolutionary technological sytems (for example, office automation).

o Clarifying the special and essential role of small firms in productivity growth, employment, and technological innovation has shifted federal policies toward increasing the opportunities for such contributions.

o Considerable research on the management of the research and development process has led to changes both within government and research organizations regarding the structure of research funding and indeed of organizations themselves.

o Research on the adoption of energy-conserving technologies and behaviors has major implications for national energy policies and programs that have been only partially realized thus far.

Despite this record of accomplishment, the receptivity on the part of American business and the federal government to social and bahavioral science findings and their implications has not always been great. Although such concepts were discussed and even applied on a significant scale in the 1970's, American business had not been very receptive to such concepts in the preceding two decades. As the Members of this body already know, this was in contrast to many other industrialized nations, particularly Japan, which borrowed liberally from, and adapted, social science findings regarding organizational processes and economic performance.

Similarly the current Administration has repeatedly indicated, both by explicit statement and also implicitly by other actions, that it feels that the social and behavioral sciences are of lower priority, if not altogether irrelevant, to economic recovery. At this time these fields are effectively ignored by the Administration's science advisory apparatus.

Suggested Roles for Government

Let me turn now to several specific suggestions regarding ways that government might strengthen these fields so that the nation as a whole can better capitalize on the resources they offer. My suggestions lie in the following areas:

o Government funding of social and behavioral research.

o R&D tax credits for research in this area.

o Strengthening the foresight capability of the society, particularly within government.

o Science and mathematics education.

o Government's role in "technical assistance" and as a partner to other major institutional actors.

Research funding. All recent Administrations have agreed that the federal government has a responsibility to provide stable funding for promising research in areas where there is not sufficient incentive for private sector support. The same argument can be made for state or local government support, which historically has been fairly small. The entire economy realizes significant gains from the government's continuing and even expanding its support of social and behavioral research in such areas as:

- Human factors and ergonomics.

- Organizational effectiveness.

- Behavior and health.

- Employee safety and behavior.

- Education and training.

- Career and occupational choices by young people.

However, federal support for social and behavioral research has suffered in recent years. These fields were singled out for sharply disproportionate cuts in funding by the Administration in its first budgetary proposals. A relatively responsive Congress -- led in large part, I might add, by this Subcommittee -- restored part of those cuts, but the effect was still severe. In the National Science Foundation, the cornerstone of the federal government's basic research support efforts, funding for the physical sciences increased approximately 60 percent from FY 1980 to FY 1984 (using the President's proposed budget for the latter time point). By contrast, support for the social and behavioral sciences decreased 22 percent, based on the President's proposal. There has been a similar pattern in several other agencies that sponsor research in these areas.

"The continued de-emphasis of social and behavioral science research is harmful for the nation's knowledge base and for its efforts to achieve economic and technological revitalization" (Tornatzky, 1982, p. 737). It is essential for the economic health of the nation that the federal government -- and state and local governments as well -- commit themselves to investments in social and behavioral research on a scale commensurate with the national and regional needs for such knowledge. The nation can no longer afford to shortchange this kind of knowledge relative to that of the other sciences.

There are some hopeful signs in this regard. The contributions of these sciences to economic productivity and the quality of employment have been recognized by several Congressional committees, particularly this Subcommittee. The Subcommittee's report of last October entitled "The Human Factor in Innovation and Productivity" contains several explicit recommendations regarding increased support for, and use of, research in these areas. In addition, this Subcommittee proposed a redistribution of funds in the recent NSF authorization bill that restored the social and behavioral sciences' support in this agency to roughly FY 1980 levels -- an action that the House of Representatives subsequently approved.

The social and behavioral sciences are grateful for such actions. We are also confident that the wisdom of these actions will be borne out, and that the benefits -- economic, social, and otherwise -- will far exceed the costs of such programs.

R&D Tax Credits. The Economic Recovery Tax Act of 1981 (P.L. 97-34) provided tax credits to corporations for most kinds of new research, as a stimulus to private sector R&D that was intended then to result in increased technological innovation and productivity. However, the Act explicitly excluded social research from qualifying for such tax credits. To single out this kind of valuable research for exclusion from favorable tax treatment is to create disincentives for firms to invest in this kind of research relative to other kinds, and perhaps thereby to fail to address intelligently problems of productivity, quality of work life, and so forth. Witnesses testifying before this Subcommittee in other hearings have recommended ending this discriminatory treatment. We strongly agree. Executives from numerous major U.S. firms have stated publicly the value of the social and behavioral sciences to their firms in enhancing productivity, employee satisfaction, the fit between person and job, and so forth. This artificial barrier to useful and productive research should be removed.

Foresight Capability. Government at all levels should take steps to strengthen the foresight capability of major societal institutions, particularly in government itself, in order to better anticipate future trends and to respond intelligently. This might include such measures as:

o Supporting methodological research to develop further the techniques of forecasting and projections.

o Strengthening governmental statistical efforts and helping to underwrite non-governmental sources of data of general public interest. I would strongly support the recommendation made by David Birch in his testimony on the opening day of these hearings that the federal government should stimulate state and local governments to collect data on changes in jobs, what new skills are required, and so forth. It is important that such research efforts at different levels be coordinated.

o Acquiring staff with technical training and experience in foresight efforts.

o Establishing institutional requirements for attention to foresight issues on the part of all governmental agencies.

Several bills designed to strengthen the federal government's foresight capability either have been introduced or are in preparation. All have merits of different sorts. I am suggesting the development of a focus specifically on issues relating to technology and employment.

Science and mathematics education. Other witnesses have spoken in detail to this issue. We simply wish to reiterate our strong support for vigorous action on this serious problem by all relevant actors: local school districts, teachers groups, parents groups, the business community, colleges and universities, and government at each level from local to federal. In addition, however, our concern is also that there be adequate research on the best ways in which science can be taught and learned. Psychologists have made significant progress in research on this issue in recent years. One example of this progress, introduced in the Congressional Record last month by Congressman George Brown, is an article by Dr. Lauren Resnick that appeared in Science, summarizing the new consensus on the nature of learning and pointing out a number of implications for how we can improve science and math education based upon this new model.

Government as "broker" and as partner. Another role for government would be to serve as a broker in facilitating the dissemination of social technologies. Central to this role would be the need to "develop institutionalized ways to identify exemplary social technologies (e.g., those with a strong research base, demonstrable benefit, and replicable procedures)" (Tornatzky, et al., 1982, p. 742). This role is fairly rare, but there is precedent for it, for example, in some of the dissemination programs conducted in the 1970's by the Department (and earlier, the Office) of Education. In addition, this model has analogues in the case of physical technologies (such as the technology transfer programs in agencies such as NASA, NIH, etc.). Generally, government's role would not be an overbearing one, but rather would be as a partner willing to seek solutions to problems with other governmental levels, industry, labor, and representatives of consumers.

Some of these suggestions are more adapted to the short-run, such as R&D tax incentives, or the "broker" role. Others will have short-run payoffs but will fully realize their promise over a longer period (such as research funding, and the strengthening of foresight capabilities). In all cases, however, the intent is for the government to strengthen these vital resources, so that the nation as a whole can make maximum use of them in addressing the critical issues posed by changes in technology for employment.

It has been a pleasure to testify before this joint hearing on these important issues. I would be happy to provide additional information or answer any questions you might have. Thank you.

Footnote

[1] The report referred to first appeared as a chapter in Emerging Issues in Science and Technology, 1981 (National Science Foundation), a compendium of Working Papers prepared to accompany the Annual Science and Technology Report to the Congress, 1981 (Office of Science and Technology Policy). It later appeared with minor revisions in the American Psychologist (Tornatzky et al., 1982). All references to, and quotations from, the report in this testimony refer to the latter source.

Mr. **Walgren**. Thank you very much, Dr. Nelson.

Well, it is an interesting range of problems that we have been presented by this panel.

I would like to first touch on what Dr. Page said about the levels of this unemployment, and the idea that the Pittsburgh area alone accounts for $20 billion in outflow from the Federal Government to manage that unemployment alone.

I cannot think of a more graphic demonstration of the dimension of the problem that we are dealing with.

It is my understanding that to a certain extent we understate the levels of unemployment in our society by not including discouraged workers in the unemployment rates. Also, as you have indicated in other forums, on a State-by-State basis unemployment is substantially understated, at least for our region, because it is spread out among the rural part of the State, as is true with most States, I know; and also Philadelphia, which is not in quite as bad shape as Pittsburgh is.

But when you actually focus on what amounts to a part of Appalachia, you find elevated levels of unemployment. And those do not include the discouraged workers rates, is that correct, Dr. Page?

Dr. **Page**. Yes.

I want to make it clear here, this is not just a doomsday situation. We are dealing with a very serious problem. But a problem to which I feel there is a way out.

Let's start with these numbers a little bit. In my opinion that is a good place to start talking about this issue.

We report unemployment in this country nationally. That is now in the range of 10 percent. We report it by State. But if you take Pennsylvania, the unemployment rate in eastern Pennsylvania is about half of what it is in western Pennsylvania, which pulls the western figure way down.

We also report by SMSA (standard metropolitan statistical area.) And in the Pittsburgh standard metropolitan statistical area the unemployment rate is about 16 percent. But in fact, if you look at the regional unemployment rates, you find that the whole region has an unemployment rate of about 16 percent.

For example, the unemployment rate in western Pennsylvania is about 18 percent, when you aggregate western Pennsylvania. The unemployment rate in eastern Ohio is about 15 percent. If you look at West Virginia, the unemployment rate is 20 percent, for an overall rate of 16.8 percent for our region.

Now, just to talk about these figures a little bit. Ten-percent unemployment rates are very serious. Sixteen-percent unemployment rates are truly alarming.

Furthermore, there is a general assumption about unemployment rates that when people go off the unemployment rates, that you are into a new business cycle, and that therefore these people have new jobs.

We cannot make that assumption here at all. There are very few new jobs, if any. And when you are talking about unemployment rates as high as 24 percent in Johnstown, I have to say to you that the figures are so soft, we have no idea what the real unemployment rate is.

The reason for that is that once the people go off the unemployment rates, they are not accounted for statistically. They are the discouraged worker.

Look. The Labor Department told me that in 1982, 50,000 people in the Pittsburgh SMSA alone lost their unemployment compensation benefits. In the first 6 months of 1983, about 28,000 additional people in our SMSA will lose their unemployment compensation benefits. They have run the 26 weeks or whatever it is—some have been extended, some not.

Mr. DYMALLY. Dr. Page, you mentioned, in passing, the discouraged worker. We discovered in this committee, this week, much to our surprise, that the discouraged worker is not included in the 10 percent national unemployment rates. If you put them in, you get another 5 percent. If you put the discouraged worker in your regional statistics, where would you end up?

Dr. PAGE. We don't know. Once they go off the unemployment rolls, they are not accounted for. They are not just discouraged—they are forgotten.

Let's make one point further about this. Not only have they lost their unemployment compensation benefits, but there is nowhere for most of them to go. We are talking here about threats to their homes, mortgage foreclosures, threats to our churches—the whole cultural pattern here is being disrupted.

Mr. WALGREN. Let me put that together with one other thrust of your testimony, and that is the other witnesses have indicated that the high-tech employment possibilities are at least limited. In fact, even in New England the growth was in other sectors, in major part. Any region that wants to pull itself up by its bootstraps has to think about more than just high tech, and that economic planning, if we are to get any recovery, has to address the basic industries as well and the industries that we would not classify as high technology industries.

Now that—I take it is obvious—leads you to recommending the kind of region-wide planning, strategic energy plans, transportation plans, environmental considerations that you have outlined in your testimony. And I guess the obvious question is, as you look at Pittsburgh and the Pittsburgh area as an example of a tag on to Appalachia, at least a possible tag on to Appalachia, you foresee the need for a very broad-based and planned attack on that region's economy.

Dr. PAGE. I think what is most important is that we think very clearly about what is happening here and what must be done.

You are talking here about people who have come out of heavy industries for the most part. Although I must say to you that the unemployment runs through every layer of our economy, except possibly the upper class.

But the technologies that are developed and the means of doing that, in my opinion, must relate to the people who are unemployed.

Now, I think technology plays a role here. But it also must be clear that you are talking about—it tends to be a relatively younger population. Because of seniority and the unions it is the younger group that tends to be laid off first. But you are talking about a third-generation steelworker who expected to go to work in the steel plant but now finds himself with a family and a home and a mortgage, and who is unemployed, and whose unemployment benefits either have or may soon run out. You have to think clearly about how he might become reemployed. And the high technology for the most part of the Boston area and Silicon Valley would not, in my opinion, relate to this subject.

I can think of ways in which robotics and other technologies might be related to coal. I am told, though I am not an expert on this subject, that robots can be used to mine coal. This approach would begin to use the resources of the region, and income would be brought into the region.

Mr. DYMALLY. What about the displacement of workers?

Dr. PAGE. High technology in fact tends to displace workers. If you look at a newspaper organization where they have brought in new technology, generally speaking there are fewer people working at the newspaper than there were before.

So, what I am saying is, it should not be assumed if you bring in new technology it is going to relate to these unemployed workers. What I am suggesting is major work programs and so forth, such as cleaning up the environment.

We have a site called Bruin Lagoon. It is one of the 20 worst dumpsites in the United States. The outflow goes into Bear Creek; Bear Creek flows into the Allegheny River. The Allegheny River is where Pittsburgh gets much of its water supply. The site has already overflowed and it could again.

But hundreds of people could be put to work cleaning up waste dump sites and rebuilding our roads and bridges and our locks and dams. These are not what I call "wouldn't it be nice" projects. They are really essential projects. We have a lock and dam in West Virginia, called Gallipolis, that is in such deteriorated condition that it could go out at any time.

We have 50 major truck routes closed because of bad bridges and so forth.

Now, where the planning comes in is—it seems to me what we need to do is look at this region. Mind you, I have not talked to you about bordering States like Michigan, which has severe unemployment. I haven't talked to you about Kentucky, another bordering State, which is one of the worst States in terms of unemployment. And I have not even talked about western Ohio, which is another very serious area.

So, the figures that I am presenting to you are, by and large, quite low.

Mr. DYMALLY. You know the 5 o'clock news—"The Economy Is Improving."

Dr. PAGE. The economy may be improving for some. I would like to remind you we are approaching a $200 billion budget deficit, perhaps larger, four times larger than any previous administration. Interest rates may go back up.

My concern here is with the region and what affects this regional economy, with a potential regional solution. You must keep in mind many of these factors on the Federal level also relate to that.

The planning comes in because it seems to me we have to set some priorities—priorities related to joblessness—priorities related to projects that, in fact, should and need to be done and which will create the maximum number of jobs. And that is where strategic planning comes in.

What we need to do, in my opinion, is to do some strategic planning that sets priorities related to jobs and joblessness.

Mr. **Walgren**. Let me ask Dr. Baumann. I know that it is wrong to think of the kind of levels that I am sure you see as solving this macroproblem of the region. And I think in a very real sense perhaps we don't look to the entrepreneurial efforts along that line, although I think we do hope that out of them may come some real key contributions that might make the rest of it doable in terms of breakthroughs, or energy systems that would be cleaner and the like.

But I would like to ask—you are in the business of looking at a whole number of candidates for entrepreneurial development—Is the dominant impression of looking at those little fish swimming and struggling there one of success or lack of success in our region?

Does that differ from other parts of the country?

And I just can't help but think—we had a witness here the other day who was in the business of trying to place handicapped employees, and the overall reaction was one of great discouragement.

I guess I would like to try to take the temperature of the entrepreneurial side of this, to see the rate of success, how difficult is it to keep optimistic, and to keep succeeding.

Dr. **Baumann**. Entrepreneurs by nature are optimistic. We are optimists in my field, the field of design.

I think the rate of survival, and I can compare it only to the Boston area—I spent 15 years at MIT before coming to Carnegie Tech—I think the rates are as good or higher, because people are not competing toe to toe. You are sort of more on your own when you start a computer firm in Pittsburgh. On the other hand, you have more people pulling for you; more people care.

I think the one thing I would like to see happen, and one of the biggest problems so far, is that we have the biggest venture capital firm in the United States in Pittsburgh. But it doesn't invest in Pittsburgh. It sees technology being somewhere else. And it invests somewhere else.

I think as we get some of these high tech-Ph. D.'s coming out of Westinghouse, United States Steel and Gulf, there will be more opportunities to invest in the Pittsburgh area.

How do you solve the problem of structural unemployment of a million people? You start 10,000 new companies. You don't have to deal with the million. You start, and very quickly they will be hiring a hundred more. That takes some time, but it is not impossible. You can start 10,000 new companies with not very many bucks, a lot less than we are now paying for the unemployment compensation.

Dr. **Page**. May I just add a comment to that?

The technology exists—was developed in the 1930's, perfected in the 1940's—for coal liquefaction and coal gasification. Why are we not bringing that technology into this region, using the resources of the region; namely, the coal and the technology which exists to get a whole new growth sector going in our economy? Why is that not being done? Should we not be doing it? What is the Federal role in that? Why is that not being stressed—pushed by our Synfuels Corporation, and by our House and Senate, and our executive branch of Government?

There is almost no discussion of that subject. Why not?

Mr. WALGREN. My time is about to expire. But I wanted to ask Dr. Nelson, to what do you attribute the lack of appreciation and pickup of the social and behavioral sciences in this whole area?

Dr. NELSON. There are a whole host of things, ranging from the relative recency of these sciences themselves to the, I believe, qualitatively different nature of the structure and the process of progress within these fields. There are not fantastically dramatic breakthroughs in these fields as there are in the physical and biomedical sciences. There have been a few exceptions.

They are cumulative in impact. They build over time. They need stable requirements for funding. Their funding has been fairly small and discontinuous in recent years, the last decade or so.

They deal with a number of human implications that run counter to the ethos of business and government as it has been expressed in this country. Also everybody believes they are a social scientist.

Mr. WALGREN. Thank you very much.

Mr. MacKay.

Mr. MACKAY. I understand specifically that the National Science Foundation has, while greatly increasing the amount of science, what you call hard science, basic research funding—has actually decreased systematically the amount of funding going into social science research. Is that correct?

Dr. NELSON. Yes. The figures that I presented in my written testimony were based upon the President's proposed budgets. The figure in the NSF authorization bill that was initiated by the Subcommittee on Science, Research and Technology redistributed funds within the total NSF budget to increase funding for these fields by $15 million, if you count the $3 million that goes into the information science program. And I regard that as one of those areas. So that brings it back up to fiscal year 1980 levels. That is the authorization level.

Now, appropriations is another matter. It has not been decided yet.

Mr. MACKAY. I would like to say, Dr. Page, I think the work that you have done is very constructive and very innovative. But it raises the question of what is the revitalization of that region, what is the Federal role and what is the regional role.

As I read your paper here, Executive summary, June 1983, it appears to me you have had trouble convincing the people in the region that they cannot solve the problem without working together. And I would say that if they don't see the problem in that fashion, would Congress, by jumping in, help things or make them worse?

Dr. PAGE. Congressman McKay, it doesn't matter where we start on this problem. We have made a number of efforts with the Federal level here to get resources brought in to deal with this problem. Now, it is difficult and it is complicated, and I don't mean to underestimate it.

The first complication arises because of the fact that it is an interstate issue and problem, and the solution lies in an interstate solution. States typically compete with one another. You are dealing with several Governors, who are members of different political parties. I think people tend to look at very traditional solutions to problems.

In my opinion, that will not work here. What is needed is some, in my opinion, strategic planning having to do with energy, transportation, and the environment, cutting across State lines—cooperation among the States, not competition, with the general recognition that they have a common problem.

The railroads run from West Virginia into western Pennsylvania and back into Ohio. The locks and dams run from western Pennsylvania into Ohio and West Virginia. Most of the 100 billion tons of known coal reserves are in the tristate area—70 percent of it. You have to go into Kentucky and Tennessee for the rest of the reserves.

So, the first point of understanding is that the problem and the solution are on a regional level involving multiple State governments and institutions. And the role for the Federal Government is to say we have here a regional problem, which has a regional solution, and we may have to do things that are not exactly traditional, although there are some precedents for this.

There is one in France, known as the Aquitaine region, wherein the French Government has decided for resource development that it will decentralize an otherwise highly centralized government and approach this problem on a regional level.

We have had the Appalachian Regional Commission, but it is located here in Washington, and it has not had the problems of the type we are facing at the present time; nor has it had the resources to deal with those problems effectively; nor, in my opinion, in terms of its organization does it cover the right area, although it covers some of that area.

But that is the type and nature of the beast that you are dealing with. You have an elephant here, and every organization has a piece of the elephant. But nobody is riding the elephant, and the elephant is staggering toward collapse.

Mr. MacKay. One of the things, Mr. Chairman, that it seems to me has been a recurring threat in this series of hearings is the lack of a data base, both on job skill availability and on job opportunity. It appears to me that we should look further into the whole question of who has a responsibility. I think it is in the Department of Labor as far as I can tell. But it appears to me that—someone said we have pre-1940 institutions trying to deal with post-1980 problems. And our data base on jobs, employment, has to be the epitome of that.

I understand just from the State of Florida that they send in the information by mail. They mail in the information to a center somewhere, and it then gets distributed nationwide several weeks or months later. So, the only thing you know for sure is that it is no good by the time you get it.

High school and college counselors trying to tell people where jobs could be available—it is strictly an Alice-in-Wonderland situation. Nobody relies on it, because everybody knows it is no good.

Now, Dr. Page puts in there the fact that even if we got it so it was electronic—and they all have computers, but apparently they don't use it for this purpose—even if we got it so it was immediate, we would still not have everybody, because the data base doesn't include people who drop off of the unemployment rolls.

Dr. **PAGE**. Excuse me.

You could solve that problem. If you were first starting with the correct data base, as being reported by the Bureau of Labor Statistics, you could set up a sampling system which would supplement that.

Mr. **MACKAY**. My proposal would be that we look at something like I understand they have in Sweden, where they have it set up with a computer so that into the computer during the daytime goes all of the available jobs in the country and also all of the people who are unemployed. At night the thing sorts and matches the two, both as to primary and secondary skills, so that you have a daily readout of what all is available.

Now, they don't use private employment agencies there. But the fact of the matter is if you could centralize the data bank, the private employment agencies could use it on a user-fee basis. And it appears to me we are never going to get at these other problems, like what should you be training people for, until we get some idea of the shifts and changes that are going on.

I would like some of you who understand this impracticality to react to that comment, because I only understand it in theory.

Dr. **BAUMANN**. Mr. MacKay, I would like to react a little bit.

Ten years ago, I first discovered people in the political scene are also entrepreneurial. I was working on a strategic plan—for the Governor of Connecticut—in transportation, which is one of my fields. He started my task description of what I was supposed to do for him by saying: "I beat that son-of-a-gun fair and square. Nothing in his plan is in my plan." So, the problem seems to be that sometimes strategic planning gets in the way.

I think I have to agree with Dr. Nelson. We need more social science in some of these areas, because what in fact happens with much planning is it takes away the opportunities to sort "forward direction" out of chaos, which is what entrepreneurs do. Some of them do it in the political realm and some in the financial realm. But that sorting process is an important one, and in some ways when we collect data and do planning, we in fact defeat that process.

I think this is why we need more research in some of these areas. I think there are a lot of other reasons. But again, to back up what Dr. Nelson said—and I testified before to the Science and Technology Committee on the lack of social science—the difference in our society and the Japanese society is that they read our social science and practice it. We don't even read it.

Dr. **NELSON**. One comment.

I think Dr. Baumann is fundamentally correct. The concept of planning, I think, has to be a dynamic plan rather than something that you cast in concrete and then work from for a predetermined period of time.

The concept, I think, means trying to extrapolate trends as best you can to determine what alternative futures there are, for the purpose of making intelligent decisions now, and tomorrow, and the next day, and a month later. And those can change. But I think that is a concept that has to begin to be implemented. Some of that is done now in business. Increasingly businesses, especially larger businesses, are developing subunits to deal with that, to monitor important societal trends.

The Issues Management Association was formed within the last 2 or 3 years and consists largely, but not entirely, of people in business who function in that capacity.

Mr. MacKay. I would like to come back, though. I am not talking about planning in the sense you are. I am talking about a dysfunction between our education system and what is going on in the rest of the world, and the fact that we cannot seem to cross that gap—one of the reasons being the people who are advising young people don't have any data on which to advise them.

Dr. Page. My friend here took a shot at strategic planning—and I am accustomed to that—in favor of entrepreneurship. But I want to make it clear that an appropriate entrepreneurship is not being used either. He testified that the venture capital that might be used for the region is going outside of the region. So long as that situation exists, we are not even moving forward on the fundamental entrepreneurship side.

I happen to favor some strategic planning, because in my opinion some priorities should be set in our region in terms of providing employment opportunities, where those might best be provided.

I am not at all posing this in contradistinction to entrepreneurship activities. On the contrary, I would favor a fairly massive effort.

Mr. Walgren. Congressman Gephardt.

Mr. Gephardt. Thank you.

This has been a very helpful panel. I am deeply interested in all that you have said. I am from St. Louis. Our problems are, thankfully, not as bad as the area the two of you are from, but they are bad. And they are similar in that we have the same kind of industrial base.

What we are searching for is an understanding of the problem, and you help with that a great deal. We are also searching for the best way that the Government can aid and help—the National Government in this case—this whole set of problems.

I am interested in the difference between Dr. Baumann's approach and Dr. Page's approach. I don't know that it is all that different, but you really suggest two different ways to spend Federal money.

Dr. Page's approach is one that would cause a great deal of money to be spent in infrastructure and public works and things that would lead us perhaps to a coal export policy, which many have talked about and feel very strongly about.

Dr. Baumann, you talk more like the David Birch's of the world, who say that the new jobs will be created in small firms, and we ought to find space for these firms to be incubated and figure out how to get them a little seed capital. All that I have heard leads me to believe maybe the seed capital is the most important part of the equation.

Dr. Birch talks about businesses starting in garages, and the problem is getting the startup money.

I guess my question is to each of you, knowing that we face gargantuan deficits, and a lot of that is caused by the unemployment we are talking about here today. If the Congress is not willing to raise a substantial amount of taxes to do a lot of these things, we are all just talking in the dark. But assume that at some point along the line we decide for one reason or another we have some money to spend on things that we need to do to try to get this economy working again and unemployment down.

In addition to the kind of things that Representative MacKay talked about, would you give me your views of how you think the money would be best spent in Pittsburgh?

Is it the kind of things Dr. Baumann is talking about, or the bigger, harder, perhaps more expensive business of trying to develop a coal export policy, which has a lot of ramifications?

Let's remember we are talking about Pittsburgh, and the very people you mentioned—people in high pay, sometimes high skills, sometimes not so high skills, but heavy manufacturing industries—that are now out of work.

Those are the people we are dealing with. Do we want to try to deal with them? Are they going to go in their garage and start an entrepreneurship?

I wish you would respond to that. What is the best thing to do?

Dr. **Baumann**. My feeling is that the biggest bang for no Federal bucks is the plan I proposed for the innovation grants. It would cost nothing at all. In other words, if you said to companies who have technology on the shelf that is better than is on the market now: We will let you bring that to the marketplace, and we will give you a 5-year exclusive right to sell it.

It will cost the Government nothing. But it will be enough incentive to get a lot of people working right away, because they will have to apply for this sort of a design patent thing and show that their widget is 20 percent better than anything on the market. As soon as they have shown that, off they go, and they continue to have that monopoly until somebody beats them by 10 percent. Then you negotiate a cross-royalty, and the cost is nothing.

It will take technology and put it to use—technology that is presently on the shelf. It will bring technology to the marketplace quickly in the United States. I think it would cost nothing.

The next level costs a little bit more. That is to take the vacant buildings and make them available. They have already been fully depreciated. All we have to do is find somebody to pay for the heat and lights. And the level above that is try to provide some seed capital.

Those are the three levels. The first costs nothing, the second a little, and the third trivially more.

Mr. **Gephardt**. Are you going to put steelworkers to work?

Dr. **Baumann**. If someone can sell me some new things that are better than I have, that is going to put the economy to work. And the reason that we are not getting these new things in the United States today is: Some of our captains of industry are scared. They no longer think it is "The American Way" to bring out new products. They are going to wait until the Japanese do it first.

Dr. **Page**. Look, Congressman Gephardt, I do not have all the answers to this problem. I want to say to you, or pose, rather, some questions to you.

You say you think perhaps it is expensive to use the coal resources. What has it cost us, this 10 years of experience, watching the price of oil go from $2 a barrel to $32 a barrel?

What will it cost us if we don't begin to concentrate on some of the resources of this country? When the price of oil—as it almost certainly will, if you understand the theory of cartels—continues to drop, at some point there will be a question of whether oil will continue to be produced, because there are fixed costs in this industry.

I just pose to you the question. I can deal with it on any level that you want—unemployment, national security, whatever. What will be the cost to us of not developing our national resources?

When we know that the technology exists to use these resources, why do we not apply that technology to the use of these resources?

What is the cost of not doing that?

In 1983 alone, 1 million unemployed workers—this is a figure we used to use in the Office of Management and Budget where I used to work—it will cost us some $20 billion. We can solve the problem for $10 to $12 billion. What does it cost us not to use our own resources to solve the problem at hand?

What will it cost us not to put 1 million unemployed workers back to work when we have the resources in the region to put the people back to work? And why do we not do that? Why do we not develop a policy of doing that?

Why do we not look at the locks and dams which must, after all, be fixed up anyway, because if one of those locks and dams goes out, it will shut down the entire waterway system or a large portion of it, knocking out perhaps the Ohio barge line and other related industries—further damaging the coal industry that already exists.

Why do we not focus on the region's resources to solve the problems of the region. I do not say to you as a responsible person it will necessarily solve all of the unemployment problems, but it would be a beginning.

You are talking about the potential in the coming months of thousands of people losing their unemployment compensation benefits. We are not talking about abstract problems. We are talking about very real, down-to-earth, gut-level problems.

Mr. **Walgren**. The gentleman's time has expired. The bells have rung. We are within about 8 minutes of a vote that we must respond to.

I think on those questions is the proper place to end the hearing today. And I want to thank on behalf of my colleagues all the witnesses for their contribution. It has been an interesting session and has really presented the hard reality that we are, I am afraid, faced with.

With that we will close. The last hearing in this series will be next Thursday, when we will have a panel on future perspectives.

[Whereupon, at 12:30 p.m., the subcommittee and the task force adjourned, to reconvene Thursday, June 23, 1983.]

TECHNOLOGY AND EMPLOYMENT

THURSDAY, JUNE 23, 1983

House of Representatives, Committee on Science and Technology, Subcommittee on Science, Research and Technology, and the Committee on the Budget Task Force on Education and Employment,
Washington, D.C.

The subcommittee and task force met, pursuant to recess, at 2:28 p.m., in room 2318, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Present: Representatives Walgren, Brown, Dymally, MacKay, Sensenbrenner, and Skeen.

Staff present: John Jerke, Thomas Kramer, Peter Maritz, and Maryanne Bach.

Mr. Walgren. This is the last of seven sessions in which the Subcommittee on Science, Research and Technology and the Task Force on Education and Employment of the Budget Committee have been exploring the problems of the impact of technology on employment. There has been a very interesting group of comments and presentations.

I could not help but notice in the evening news, the network news the other night, where they were talking about the reactivation of various plants around the country as the economy comes out of recession, but noting they had taken the opportunity during the time the plants were essentially closed to eliminate a number of jobs at the General Electric plant in New York and the Kodak plant in Rochester. So, through automation the plants were functioning again and the products were now coming off the line, but the workers in many senses were not called back to work. That is an underlying element that has interested this committee, this particular member, and one of the things that we will be pondering as we gather the views of the witnesses together and try to develop a report from these hearings.

I want to welcome the Honorable Ed Zschau from California, the San Jose area, our colleague from the Silicon Valley area, as a leadoff witness on this last day where we are going to try to go toward future perspectives on the impact of technology.

We certainly appreciate your giving the time to come to the committee and be part of this record. I would like to invite you to participate after your testimony if you can. I know that we would welcome you.

We are very interested in hearing your views and what perspectives you can give us on the developments in California, in view of your involvement with that community.

Welcome to the committee. Please proceed as you would like.

[The biographical sketch of the Honorable Ed Zschau follows:]

Ed Zschau, Republican, of Los Altos, Calif.; born in Omaha, Nebr. on January 6, 1940; attended public schools in Omaha; graduated, Westside High School, 1957; A.B. (cum laude) Princeton University, Princeton, N.J., 1961; M.B.A. (1963), M.S. (1964), and Ph. D. (1967), Stanford University, Stanford, Calif.; assistant professor, Graduate School of Business, Stanford University, 1965–69; visiting assistant professor, Harvard Business School, 1967–68; founder and president, System Industries, Inc., 1968–82; director, American Electronics Association, 1974–79, and chairman, 1978; director, American Council for Capital Formation, 1979–82; married to the former JoAnn Wiedmann, 1963; three children: Ed, Liz, and Cameron; elected on November 2, 1982 to the 98th Congress.

STATEMENT OF HON. ED ZSCHAU, A MEMBER OF CONGRESS FROM THE STATE OF CALIFORNIA

Mr. ZSCHAU. Thank you very much, Mr. Chairman.

Let me begin by commending you and the subcommittees for holding these hearings. I think it is extremely important to understand the relationship between technology development and employment opportunities in our country. It is an intricate relationship. It is one that has to be understood in order to formulate proper Federal policy.

I also want to thank you for the opportunity to appear before the committees.

Just to give you a little bit of background about my perspective, for 13 years I was chief executive officer of an electronics company, System Industries, in northern California that I founded in 1968. When I left the company, it had grown to about 550 employees.

In and around my district, there are approximately 700 high technology companies. It's often called Silicon Valley. It is from that perspective that I will be making my remarks today.

Mr. Chairman, I want to commend you for the very distinguished group of witnesses that you have had. I have reviewed some of the testimony that you have received in the hearings. I have been fascinated by the diversity of perspective and conclusions. I was particularly intrigued with the suggestion that we should be concerned about the growth and pervasiveness of technology as it might affect employment here in the United States. You have heard testimony that suggested that technology advancements could possibly cause a loss of jobs, that technology advancements would create jobs that might require less skill and be less interesting than the ones that are replaced, and testimony that referred to technology as a "potential threat" to employment opportunities.

Mr. Chairman, I submit that as far as U.S. jobs are concerned, the threat is not technology; the threat is not a change in products and markets. Rather, I would submit that the threat is lack of change. The threat is lack of growth. The threat is lack of competitiveness and the loss of market share. The real threat is losing our technological leadership. It is on that premise that I will be basing my remarks.

I think it is important, first of all, to be realistic about the positive impact that technology can have on employment opportunities. Technology, technological advances, technology companies are not the panacea for all economic problems we might have now or in the future. We are not going to be able to replace all of the jobs in the mature industries that we are concerned about losing with new jobs in high technology.

In order to put that in perspective, I might just point out that there are only 2 million jobs in the whole electronics industry today, including the service jobs, the software programer jobs, the sales jobs, as well as the manufacturing jobs. The electronics industry, which has had an excellent performance and growth in job opportunities, is still a very minor part of the overall work force. In short, the numbers do not add up. Those people who say that we ought to be forgetting the so-called mature or smokestack industries and put resources into technology industries have not added the numbers up. Technology is not the panacea.

However, I believe that technology has a role to play, not just in the creation of new jobs in its own industry, but also to make those industries that we have referred to as the dying industries or the smokestack industries more competitive. The automobile business is not disappearing like the buggy whip business did in years past. The steel business is not disappearing. The durable goods industries are not disappearing. The problem is that we have been losing market share. We are losing market share because we are not as competitive as we should be vis-a-vis our trading partners. I feel that technology has a role to play in making those mature industries competitive once again and enabling us not only to retain those jobs, but to expand our market share, particularly in specialized niches.

People say, "But aren't jobs lost to technology? When you automate a plant," as you referred to, Mr. Chairman, "don't you lose jobs?"

I believe we create jobs through the use of technology overall. The reason we do this is that technological advances augment human skills. They make new tasks possible that were not possible before. Perhaps jobs as we know them now, certain jobs, may be lost and replaced through the process of technological change, but we are able to do new tasks that we could not do in the past. That creates the opportunity for new jobs.

Let me give you a specific example that may illustrate this point. Back in the 1950's, there was a group at Princeton University in the economics department studying the impact of a new machine that had recently been built down the road at the University of Pennsylvania. This machine was the ENIAC, the first digital computer. They did an analysis of the tasks that were being performed throughout industry and government and tried to estimate, if we had computers rather than people doing these tasks, how many computers of the ENIAC variety would be needed. They arrived at an estimate of 40. They felt that the total market requirement for computers would be 40 computers because that many could do all the computational work that was being done then.

Where did they go wrong? They forgot to look at the impact of the computer on the ability to do jobs that could not have been done before. We in my former company, for example, could not do inventory control before we had a computer. We did not have clerks trying to do it, because we knew it could not be done efficiently. However, with a computer we implemented inventory control procedures which required several new skilled positions within our company.

My company, when it first started, made a scientific instrument computer system that enabled scientists to do work that they could not have done before. It is this impact of technology—the ability to do jobs that were not available before—that creates new employment opportunities.

In summary, I believe technology has a role to play in our future economic growth. It can make us more competitive as well as developing new products and markets, but we have to maintain or increase the rate of technological leadership.

The question then arises: How do you do this? I guess this gets into the future perspectives that I would like to talk about.

If we as a country want to do what we can to advance our technologies and thereby create the opportunities for new jobs and increase trade competitiveness, what is the proper role of Government?

There are many ideas floating around this town these days. Some people have suggested that we establish some sort of a high-technology planning board. They say we need direction in this country to focus resources on the technologies and the opportunities that are going to make a difference. My personal opinion is that that approach is doomed to failure. It is an approach, however, that has some appeal because we look across the Pacific Ocean to Japan and we see MITI, the Ministry of International Trade and Industry, apparently doing the strategic planning for the Japanese industries, in general, and high-technology industries, in particular.

We talk about the "targeting" of the winners and the losers—the process of targeting that appears to have been so successful for the Japanese. My personal feeling, again, is that that is an improper role for this Government. Rather than targeting technologies or rather than targeting industries, rather than targeting the products or companies, we should have a targeting strategy, but our targeting strategy should be to target the process of innovation. That is, Government actions should be targeted on creating an environment in this country in which innovation—technology advances—can flourish.

I have some ideas about how to do this. Let me summarize them briefly before I conclude.

It appears to me, based upon looking at the plethora of technology developments that have taken place in the Silicon Valley area, from the transistor, integrated circuit, microprocessor, personal computer, genetic engineering—those technologies that have turned into industries within the confines of my congressional district—I have seen four prerequisites that were necessary in order for those technological developments to occur.

No. 1, a commitment to basic research—fundamental research—trying to understand how the world works. Companies such as Genentech, which have developed human insulin and growth hormones through gene splicing, got their technology, not through their own basic research, but from the university research funded by the Federal Government in the area of DNA. It was conducted just to try to find out how the human body works, to understand a mysterious process. Out of that fundamental research came some techniques which later could be exploited. However, without basic research, without a continued commitment to basic research in this country, we are not going to have the technical foundations for future products.

The second prerequisite, in my opinion, is to have an environment with ample incentives for risk takers. In technological innovation, you do not get anywhere on a safe track. Risk taking is part of the deal, whether it is risk taking for the entrepreneur who starts a company, like I did, in his living room, whether it is risk taking for the innovator trying a new idea in his company, whether it is risk taking for the company to spend money on research—many of the R&D dollars do not produce a return—or whether it is risk taking for the investors that are necessary to fund the growth and startup of these companies. We need those kinds of incentives in this country.

The lowering of the capital gains tax in 1978 and again in 1981 has had a dramatic effect on the availability of venture capital. The number of new companies starting these days is dramatically up over what it was in the mid-seventies.

The R&D tax credit, which I hope will be made permanent by this Congress, is another example of an incentive that appears to be working to stimulate risk taking.

The third prerequisite for technology advancement is the availability of trained technical people. You can have all the research you want, all the incentives you want, and if you do not have the people to do the work, the engineers, the scientists, the technicians, then you are not going to be able to maintain your technological leadership.

We in this country are falling behind in our educational system. The United States, a country with twice the population of Japan, turns out fewer engineers per year than the Japanese do. Why? Because our colleges and universities do not have sufficient capacity in their engineering and science programs. The requirements for engineers in this country has increased, whereas the availability of seats in the classrooms of engineering schools has stayed constant. It looks like over the next 5 years we are going to have a shortfall of 90,000 electrical engineers and computer scientists in this country—the difference between the requirements that business sees and the number of trained people we are producing.

I think it is a financial problem. We are not able to pay the faculty sufficiently to retain them. We are not able to provide the equipment that is necessary to train engineering students. Yet, it is a problem that Government and business working together can solve. I say that because business has a stake in making sure there is adequately trained personnel.

In our company, if we did not have enough people available to hire, we could not grow.

Initiatives such as tax credits for contributions to engineering and scholarship programs have been proposed in the Congress. I think we are in the right line in such incentives.

I also think expanding the deduction that we now give for donations of equipment for research uses in colleges and universities to include equipment for educational uses would be another initiative that is appropriate.

In addition to those three prerequisites I mentioned—research, incentives for risk takers, and the availablity of trained technical people—*you need opportunities as well.* People are not going to take the risks to develop new ideas without adequate opportunities. That means a strong U.S. economy but, in addition, an aggressive trade policy.

I think we have made a mistake, for example, in agreeing to eliminate the DISC, the Domestic International Sales Corporation, which provided deferred taxation on profits from exports. DISC provided a major motivation for small companies to export.

Coming up next month on the House floor will be the Export Administration Act, which deals with export controls that impact on many high-technology companies. Again, if we try to control too much and too broadly in the name of national security, we may be spreading our enforcement resources too thin to be effective and, in addition, inhibit the exports that are so necessary in order to provide adequate opportunities for the high-technology companies.

Let me summarize very quickly. I think that the threat to jobs in this country is not technology, but a lack of technology, a lack of growth in markets, a lack of competitiveness. As I say, technology development and its applications, not just in new industries but older industries, too, has a role to play in maintaining and expanding jobs opportunities.

The proper Government policy, in my opinion, is not to target on certain technologies or opportunities, but to target on the process of innovation, to create an environment in which innovation can flourish. We can do so by a constant, dedicated commitment to basic research, providing incentives for risk takers, an education system that provides adequately trained personnel, and expanding our opportunities both domestic and foreign.

Mr. Chairman, I would like to thank you very much for the opportunity to present these ideas to you and the committee. I would be pleased to answer any questions you might have.

Mr. WALGREN. Thank you very much, Mr. Zschau.

Are there other thoughts?

Buddy.

Mr. MACKAY. I think you are on the money. I would like to put one more idea out, to which I am not fully committed. It has come up in the course of these hearings, and I would like to test it against your thinking.

One of our witnesses made a very persuasive case that in order to achieve a real commitment to technological change and more rapid change it had to create an environment in which our workers felt that change was not a threat, but one in which they were secure with change. His point was that we ought to look at some policies—for instance, the policy in France, as I understand it, is that you, not only as a company, would contribute to an unemployment fund, but that fund could also be used for retraining workers—some commitment that would make a worker realize that the loss of a job is not necessarily disaster to his family. Now, this would mean a relook at the whole idea of employment security.

In some ways, I guess people would say it would be taking Government into areas where traditionally in this country Government has not gone. Yet, I am asking, do you see this as a dimension that we need to rethink if this country is going to fully commit itself to technology and is it going to be something for all of us? I am not trying to put forward an agenda of mine. I am just trying to explore the idea.

Mr. **Zschau**. I have to admit that, coming from the area where I have come from, there has not been the same sort of concern about job security, because in that area the companies have been expanding and have been fighting, literally fighting, for employees. I have not seen that kind of situation in my own district to know it firsthand.

However, let me just make a comment about the retraining. I believe that if we ignore that process of some jobs changing or being eliminated and new jobs being created, and the problem of transferring from one type of employment activity to another, we will have overlooked a very substantial obstacle to change. When you have a problem like that and you are not dealing with it, then you will get people trying to stop it from happening and create an obstacle to change.

I feel, however, that here again a partnership of business and Government is probably the most important. I am concerned about Government training programs that train people for jobs that do not exist. However, a partnership, some sort of Government-sponsored or assisted training program would better guarantee that the jobs people are being trained for will be those that the businesses really require. The businesses would be contributing not only the opportunities, but part of the funding for it. They are not going to be training people for jobs that do not exist.

Mr. **MacKay**. I am not sure I fully understand the program in France, and I am not sure that I am describing it the way it is. However, if a program could be set up so that the company had a responsibility to contribute a certain amount per worker to a fund, and the company at its option could then use this money for its own training program, and if it could conduct the training and it could be its brother's keeper in the sense that it could see to it that its employees were insulated from the chaotic effects of rapid change, then it could have back the money it could save.

In other words, if it would conduct itself in a way that brought its employees with it, then it would not be put to extra expense, but it would bear part of the risk of taking a change in direction that left its employees high and dry.

Mr. **Zschau**. It is an interesting idea that I think ought to be explored further. A mechanism of incentives for training as well as funding for training makes some sense to me.

Mr. **MacKay**. I guess another variation—and, Mr. Chairman, I do not want to take too much time—would be an expansion of an IRA in which for a period of time an employer would match the employee's contributions until it reached a certain point. Then, the employee would have that money available, and he could make the retraining decisions himself. If he had to retrain, he then would be able to deduct the money that he put back in to build it up again. You could put the responsibility either at the industry level or at the employee level, and Government, in effect, would be participating by, one, mandating it and, two, giving a deduction for the money that went in. However, Government would not be running the program.

Mr. **Zschau**. I think these are interesting ideas. The point I made earlier is that we cannot ignore the problem. It is not only a problem that results from change, but it could inhibit change if we do not solve it. It very important to deal with directly.

Mr. **MacKay**. Thank you.

Thank you, Mr. Chairman.

Mr. **Walgren**. Mr. Skeen.

Mr. **Skeen**. Thank you, Mr. Chairman.

Congressman Zschau, I want to say to you right off the bat that I think your testimony today has been one of the most enlightening in this area amongst all the other good testimony that we have had on the topic. It is just as clear to me, and you brought a great deal of lucidity to this question particularly with your emphasis on the fact that it is our technology—not to be feared—but to be respected and built on.

For quite a number of years now, we, in the United States, because of our affluency in relation to other countries and our great advancement, have been the model for the rest of the world for a long time. I do not say that to be arrogant or immodest or in any way to denigrate the position of other countries because they, in fact, have done an excellent job of catching up with us over the last number of years. However, now we find ourselves looking over our shoulders at our students—the Japanese, the Germans, and other nations. They had a lot of room and they have made a lot of progress.

The one thing that I think you highlighted in your summary is that the entrepreneurial incentives that we have tried to restore in the last several years are extremely important, and so is the emphasis on productivity. What does it mean in jobs? We hear about, for example, that the smokestack industries are going to disappear.

I am not asking you any questions; I am just complimenting your statement because I think it was so excellent. Yes, they are going to disappear, but what is going to supplement them? Are we going to not make automobiles? You bet we are going to make automobiles. We are going to make the best automobiles in the world. In fact, we always did until we got fat and flabby about the way we made them and refused to advance or allow our own advancement in technology to survive and become supreme in the design and the production of these automobiles.

We are not going to change that drastically, but we are going to have different forms of energy, the technology of change itself.

Rather than worrying about what it does to the employment base, we ought to be concentrating on just how important that base in the advancement of technology is in supplying employment base, the technology and the change. Because, for instance, we are not going to be heating or smelting with smokestacks any longer. We are going to use another form of energy. We already have it available to us. We are just fooling around before we decide what we are going to commit ourselves to.

We know that we can use coal in much cleaner states than we have ever done before or in conditions. We understand the chemistry of that kind of energy production, but we have not gotten around to it. The day that we think that we have to go back to being like the Japanese, because we are not that kind of a culture at all—we are not a homogenized group of people as they are. They are a small island group. They are very dedicated, very industrious people, but if you think that is the answer to the U.S. employment problem, I think we are sadly mistaken. We can learn a lot of lessons, but we still have forgotten a lot of our own expertise. We have also forgotten to have some confidence in our own future.

I find the whole tenor of what you had to say a resupporting of what we have done in the past and what we can do. We need to, once again, dedicate ourselves to being a productive people and an efficient producer. However, it all relies basically on our technology.

I think you bring a great deal of fresh insight, as one who started a business in your living room and expanded it into a very worthwhile enterprise. That kind of chance is still in this country. It is the only country amongst all those that we keep talking about where that is still a possibility, and an everyday possibility, so long as we rely on ourselves and have some confidence in ourselves and quit worrying about the bad things. We quit being risk-takers some time ago, because it got very comfortable to say, "Well, we are an affluent Nation; we are great technologists." It has been very easy for us up to this point. "We led the rest of the world, and now we can kind of sit back and relax." We have to quit relaxing and go back to work!

Thank you, Mr. Chairman. Now that I have pontificated on that point, I do want to compliment you on your testimony, Mr. Zschau. It is excellent. I think it was outstanding.

Mr. ZSCHAU. Thank you.

Mr. WALGREN. On behalf of the two committees, we certainly appreciate your contribution.

Mr. SKEEN. Mr. Chairman.

Mr. WALGREN. Mr. Skeen.

Mr. SKEEN. May I ask one more question?

Congressman, we are having hearings on Wednesday and Thursday of next week, a joint session of I&O and Science, Research and Technology, along the same lines. I think that you would be a very welcomed addition to that joint subcommittee hearing, if you have time. I know that your time is as limited as the rest of us.

Mr. ZSCHAU. I would be honored to be able to participate.

Mr. SKEEN. They are hearings on joint ventures in research and development, and then, secondly, about the antitrust provisions, and so forth, and how they impinge upon this thing.

Mr. ZSCHAU. I have some thoughts on that issue.

Mr. SKEEN. I would like very much to have them.

Mr. ZSCHAU. Thank you.

Mr. SKEEN. Thank you, sir.

Thank you, Mr. Chairman.

Mr. WALGREN. I understand that you may be scheduled to testify on the 12th of July in that same hearing sequence. Please know that we would be pleased to have you participate with our committee, so we will work that out.

Mr. ZSCHAU. Thank you very much.

Mr. WALGREN. Thank you very much on behalf of the committee.

The first panel today is made up of Elmer Chatak, the secretary-treasurer of the Industrial Union Department of the AFL-CIO, and Roger Brinner, group vice president and director of Data Resources, Inc.

Would those two gentlemen come forward?

Welcome to the committee.

Your written statements and anything you would like to submit will be made part of the complete record. Let me ask you to take somewhere in the range of 10 minutes, or a little bit more if you wish, on an informal basis and communicate to the committee as you feel most effective.

We will start with Mr. Chatak and go right on to Mr. Brinner and then come back for some discussion.

Mr. Chatak.

[The biographical sketch of Mr. Chatak follows:]

Industrial
Union
Department
AFL-CIO

Howard D. Samuel, President
Elmer Chatak, Secretary-Treasurer

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Biography of
Elmer Chatak
Secretary-Treasurer, IUD

Elected secretary-treasurer of the AFL-CIO Industrial Union Department in September 1979, Elmer Chatak is responsible for administering the financial affairs of the department as well as providing direction to its organizing and coordinated bargaining activities.

Chatak brought to IUD a background of 28 years' experience in the labor movement, including an earlier five-year period with the department. He is regarded as a union organizer's organizer because of the depth of his experience and his remarkable record in winning NLRB elections. One of the highlights of his career as an organizer was directing the successful campaign in 1978 at the Newport News Shipyard in Newport News, Virginia, that involved 19,000 employees. At that time, Chatak was organizing director of the United Steelworkers of America.

Chatak was born and raised in the mining and steel towns of western Pennsylvania. Right out of high school he quickly joined Local 12 of the United Glass and Ceramic Workers when he worked as a glass cutter's helper at the Pittsburgh Plate Glass Company in Creighton, Pa. He later became active in USWA Local 1974 when he was a laborer and inspector at the Central Iron and Steel Company's rolling mill in Harrisburg, Pa. His present union card is the USWA Local 8888 in Newport News.

In 1951 Chatak was appointed to the CIO organizing staff and participated in many organizing campaigns of the CIO affiliates. Five years later, he was transferred to the USWA's District 7, based in Philadelphia, where he became the district's key organizer.

The Steelworkers loaned Chatak to IUD in 1963 to serve as organizing coordinator for the Mid-Atlantic cooperative organizing campaign, directing a staff of 35 organizers from 20 international unions. His win record of 153 of 197 campaigns covered 31,500 potential new members.

In 1968, Chatak returned to USWA to establish an organizing department and serve as the first director, a post he held until his election in 1979 as IUD secretary-treasurer. During that period about 3,000 bargaining units with over 250,000 workers were organized into the union.

As USWA organizing director, he also was responsible for resolving inter-union disputes and Article XX cases. He further handled special assignments such as assisting in implementing the merger of District 50 and settling the long strike at Dow Chemical's major complex in Midland, Michigan.

Born on December 15, 1929, in Acmetonia, Pennsylvania, Chatak is married and has three daughters.

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STATEMENT OF ELMER CHATAK, SECRETARY-TREASURER, INDUSTRIAL UNION DEPARTMENT, AFL-CIO, ACCOMPANIED BY RICHARD PROSTEN, RESEARCH DIRECTOR; STEVEN BECKMAN, RESEARCH ANALYST; AND BRIAN TURNER, DIRECTOR OF LEGISLATIVE AND ECONOMIC POLICY

Mr. CHATAK. We have submitted a complete statement, in accordance with the suggestion of the committee. I have a summary of that statement which I am going to present.

Mr. WALGREN. Please proceed.

Mr. CHATAK. The Industrial Union Department has 57 affiliated unions which represent approximately 5.5 million workers. Many of the members of our affiliates are employed in industries that are very likely to feel the impact of technology.

Several of my associates are with me here today. To my right is Richard Prosten, director of our Research Department; his assistant, Steve Beckman; and our legislative director, Brian Turner.

The current concern of industrial unions with technology stems from the potential for widespread and rapid application of computers, microprocessor controls, and computer-driven equipment in manufacturing. In the 1980's, not only can individual machine operations be automated, but the entire workplace can be reorganized and fully automated from receiving inputs to machining, intermediate stage transfers, assembly and final product storage and retrieval. These changes can dramatically reduce the need for human labor. It is the goal of the labor movement to insure that these industrial changes benefit the workers affected by improving their work environment, enhancing their contribution in the production process, and raising their standard of living. If this can be accomplished, the social life of our Nation will be enriched by the application of new technology.

Before directly focusing on the impact of technology on employment, I would like to discuss the job outlook for the U.S. economy. The Bureau of Labor Statistics estimates an overall increase in employment of 17.5 million or 17 percent from 1980 to 1990. The projections include gains of 49 percent for computer programers, 68 percent for computer system analysts, 72 percent for computer operators, and 93 percent for data processing machine mechanics. However, the low levels of current employment for these jobs compared to other occupations make the percentage gains deceptive. These occupations will account for only 460,000 additional jobs in 1990.

Of all occupations, the four in which employment will grow the most over this period are projected by BLS to be secretaries, nurses aides and orderlies, janitors, and sales clerks. These occupations will provide 2,188,000 new jobs, five times more than their high technology counterparts.

According to the most recent BLS figures, the ranks of the unemployed, including discouraged workers who are unemployed but have given up looking for work, number about 13 million. In addition, there are nearly 6 million workers on voluntary part-time schedules, for a total of 19 million Americans unable to find needed full-time employment.

The picture posed so far looks rather bleak. The bulk of jobs expected to be available require very little skill and are low-paid occupations in low-paid industries. This picture stands in sharp contrast to the glorious future predicted with blind certainty by some economists and politicians. That view is reflected in the econometric analysis contained in the testimony of Professors Almon and Buckler. The "high tech" industries they expect to brighten prospects for the future, even as broadly defined by BLS, make up only 4.6 percent of American industry's employment, and the jobs requiring the extensive math and science training—they say must be taught in our schools—make up only about 15 percent of all jobs in even those industries. We believe that without changes in the way new technology is introduced and in public policy dealing with employment and and unemployment, we will face a bleak rather than a bright future.

New technology will not only affect the types of new jobs that will be available in the future, it will also affect existing jobs. For industrial workers, there is an ominous possibility that there will be less skill required in many current jobs as well as new jobs, and less worker influence on work than is now the case. The prospect of a manufacturing work force with lower skills implies lower pay as well. The gulf between production workers and technical and engineering staffs may widen enough to become impassable. There would be no chance for advancement for the majority of workers.

Computerized machinery's capacity to record and control the pace of production work creates the potential for a polarization between those with advanced skills and those without them. This same equipment allows certain work to be performed in homes and other decentralized workplaces. While this development has been welcomed by some, it creates the potential for high technology versions of all the evils traditionally associated with industrial homework. We see these possibilities as a danger to community and regional patterns of employment and income distribution.

Unions have actively pursued the interest of their members and their communities when technological change has been a disruptive force. Bargaining objectives have included contractual provisions for advance notice, retraining, skill development, job and income security, and recall rights. Unions have been negotiating a variety of contract provisions for workers affected by new technology for many years.

In our latest study of major collective bargaining agreements, published in January 1982, nearly 25 percent of the contracts contained specific provisions for advance notice to the union when new technology is introduced, and over 10 percent required employer-provided training for a new job within the company for workers affected. Industries with such provisions range from auto, metal containers and steel to textiles, printing, and newspapers.

The training and retraining of workers displaced by new technology has become a prominent issue of public concern. Union efforts in this area focused on employer-provided retraining. In most cases, contract-mandated retraining is for other available work in the plant. This retraining is usually of short duration and does not significantly alter the type of work performed by the individual worker. However, when more workers are displaced than can be reemployed within the plant, the inadequacy of this type of retraining becomes clear.

Unions have proposed that work which replaces existing jobs should be performed by those now doing such tasks. In this way, workers' skills, pay, and job input can grow with the sophistication of the equipment they use.

Several unions have taken steps to make technology central to their bargaining goals. One of our affiliates, the Communication Workers of America, just announced their 1983 bargaining priorities for negotiations with the Bell System. Their demands include full protection from technological unemployment and erosion of jobs and a national labor-management committee on technological change.

The International Association of Machinists, also an affiliate of the IUD, has proposed a technological bill of rights mandating, for example, that technology improvements do not reduce jobs, improve the conditions of work, and expand workers' skills and knowledge, and that cost savings be shared with workers. We have attached a copy of this document.

Unfortunately, the impact of technology on jobs cannot be contained within the collective bargaining sphere alone. The methods we are now using to distribute the benefits of new technology and its related higher productivity have proven inadequate—inadequate to safeguard the employment and income security of working people. How can we insure that investment will be sufficient and income distribution appropriate for generating full employment? How can we assure that new technology will result in upgrading workers' skills and increase their workplace contributions when the choices of equipment design, how much new equipment to buy, how and where to use it, are all made by management with no input from the workers who will be directly affected?

It is time to consider shortening the standard workweek to generate more jobs. While productivity has nearly tripled since the passage of the Fair Labor Standards Act, the statutory workweek has remained constant at 40 hours. As Lynn Williams of the United Steelworkers of America testified before this committee, and I quote, "The labor movement always has believed that a reasonable social contract should include a full employment commitment. But that doesn't mean 40 hours a week and retirement at 65 when circumstances cry out for a lowering of those figures."

Despite the "hallelujahs" of the crowds, new technology may prove to be an engine of disruption and discontent rather than the salvation of our society. We must view the issue with more sophistication than it currently receives in the press and with an historical perspective that includes the unemployment rates now prevailing and the types of jobs which have become available in the past and that are likely to appear in the future.

Just as a side note, I want to assure this committee, as a matter of public record, that we in the labor movement are not opposed to technology. Our concern is the impact and the effects on the workers involved—that there be a fair distribution and a proper system for dealing with displacement. We welcome the innovations. I want to establish that clearly.

I want to thank you, Mr. Chairman, for the opportunity. I want to commend you, likewise, for bringing this subject to broader public attention.

[The prepared statement of Mr. Chatak follows:]

Statement of the Industrial Union Department, AFL-CIO

By Elmer Chatak, Secretary-Treasurer

On Technology and Employment

Before the Subcommittee on Science, Research and Technology

Of the Committee on Science and Technology

And

The Task Force on Education and Employment

Of the Budget Committee

United States House of Representatives

June 23, 1983

Industrial Union Department, AFL-CIO
815 Sixteenth Street, N.W., Washington, D.C. 20006
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Howard D. Samuel, *President*
Elmer Chatak, *Secretary-Treasurer*

About IUD

The Industrial Union Department is the largest of the AFL-CIO's constitutional departments, with 57 affiliated unions representing 5½ million members.

As a constitutional department, IUD is a semi-autonomous branch of the AFL-CIO. The department is financed directly by per capita payments from its affiliates. It is directed by a president and a secretary-treasurer who are elected at biennial conventions. The governing body is an executive council composed of the two officers and 24 members, who are principal officers of affiliated unions.

History

The IUD stems from the 1955 merger agreement between the AFL and the CIO, which provided for a new industrial union department within the merged federation. Walter Reuther, then CIO and UAW president, was elected its first president.

Reuther was succeeded in 1968 by I.W. Abel, president of the United Steelworkers of America, who served until 1977. Jacob Clayman succeeded Abel for one term, until 1979, when Howard D. Samuel was elected president and Elmer Chatak, secretary-treasurer. Clayman had served as IUD secretary-treasurer from 1975 to 1977. James Carey, former IUE president and CIO secretarial treasurer, was the department's first secretary-treasurer, in office from 1955 to 1965.

Function

From its inception, the function of IUD has been to provide support services to affiliated unions in those areas where they share common concerns and where special efforts are needed to supplement the work of individual unions and the AFL-CIO.

IUD has a tradition of working with coalitions to strengthen labor's position on key issues. The department helped create the OSHA/Environmental Network, the Full Employment Action Council, the Consumer Federation of America, and a number of others.

Programs

Organizing – More than one-third of IUD's resources are devoted to organizing. The department initiated the concept of cooperative organizing under then President Reuther in 1963, and has provided major support for many organizing campaigns since then. Under this approach, unions assign their organizers to work under the direction of an IUD coordinator. The method encourages cooperation among affiliates through the pooling of available resources and virtually eliminates jurisdictional disputes. The organizing section is located in Atlanta, Ga., with field offices in the Mid-South and Southeast.

Coordinated Bargaining – Another hallmark of IUD is coordinated bargaining, which brings together different unions having contracts with the same company to give them stronger leverage at the bargaining table. More than 40 unions participate in 71 different company committees, involving about 2,200 bargaining units and three-quarters of a million workers.

Safety, Health & Environment – Ever since it played a leading role in passage of the 1970 Occupational Safety and Health Act, IUD has taken the initiative in the courts and in legislative battles to assure proper implementation of the law. Through its work with the OSHA/Environmental Network, the department also has helped defend environmental protections.

Economic Policy – IUD has responded to downturns in the economy by examining and calling attention to the long-term problems faced by America's industrial sector. The department is a prime mover in efforts to develop a national industrial policy for the U.S. that will revitalize the industrial sector.

International Trade – This area has been an important concern to IUD because of the enormous impact that the policies of foreign governments have on U.S. industries and industrial union members. IUD continues to develop analyses, educational efforts and legislative approaches to key areas of trade policy, often through coalition activities.

Pensions – IUD monitors regulatory and legislative activities that could affect the status of benefit plans negotiated by its affiliates. The investment policies of private pension plans are an area of special concern for the department, which publishes *Labor & Investments*, the principal publication in this field.

Howard D. Samuel President

Howard D. Samuel's career in the labor movement has spanned more than 30 years, and culminated in his election as president of the IUD in September 1979. For most of the period 1949-77, he was associated with the Amalgamated Clothing Workers of America, first as an organizer, then assistant president and from 1966 as an international vice president. He directed the union's political and legislative activities and as head of its union label department coordinated the union's boycott campaigns.

From January 1977 until his election as IUD president, Samuel was deputy under secretary of labor, directing the U.S. Labor Department's International Labor Affairs Bureau.

Samuel has been active in politics, serving as a delegate to state and national Democratic conventions, and has served on several government commissions and on the boards of numerous community organizations. A graduate of Dartmouth College, he also co-authored two books on government.

Elmer Chatak Secretary-Treasurer

Elected IUD secretary-treasurer in September 1979, Elmer Chatak is responsible for administering the financial affairs of the department as well as providing direction to its organizing and coordinated bargaining activities. Since 1951, he has been involved in union organizing campaigns, first on the CIO staff for five years, then with the United Steelworkers.

The USWA leaned Chatak to IUD in 1963 to serve as organizing coordinator for the Mid-Atlantic cooperative organizing campaign, directing a staff of 35 organizers from 20 unions. His win record of 153 of 197 campaigns covered 31,500 new members.

In 1968, Chatak returned to USWA to establish an organizing department and serve as the first director, a post he held until being elected IUD secretary-treasurer. During that period, about 3,000 bargaining units with over 250,000 workers were organized into the union.

Chatak was born on December 15, 1929, in Acmetonia, Pennsylvania.

My name is Elmer Chatak. I am Secretary-Treasurer of the Industrial Union Department of the AFL-CIO. Our department has 57 affiliated unions which represent approximately 5.5 million workers. Many of them are employed in industries that are likely to feel the impact of new technology. Appearing with me today are Richard Prosten and Steven Beckman from our Research Section and Brian Turner of our Legislative Section.

The current concern of industrial unions with technology stems from the potential for widespread and rapid application of computers, microprocessor controls and computer-driven equipment in manufacturing. In the 1980's, not only can individual machine operations be automated, but the entire workplace can be reorganized and fully automated from receiving inputs to machining, intermediate stage transfers, assembly and final product storage and retrieval. These changes can dramatically reduce the need for human labor. It has been estimated that currently available robot technology could replace about 2 million workers. It is the goal of the labor movement to assure that these industrial changes benefit the workers affected by improving their work environment, enhancing their contribution in the production process and raising their standard of living. If this can be accomplished, the social life of our nation will be enriched by the application of new technologies. Presently, technology is not being applied in this manner; it is often used as a means to reduce skills, reduce wages, lower living standards, and increase arbitrary management control over workers on the job.

While unions have addressed technological change as an issue for collective bargaining, its impact cannot be contained within that sphere alone. The recent shift of hundreds of assembly jobs overseas by Atari shows that so-called "sunrise" industries, based on advanced technologies, may not be stable sources of employment in the future. Efforts to address technology's effects, thus, are linked to other national economic and industrial policies that the labor movement advocates. When looking at the adequacy of responses to the introduction of new technology, both the bargaining and public policy spheres must be considered.

Before directly focusing on the impact of technology on employment, I would like to discuss the job outlook for the U.S. economy. The Bureau of Labor Statistics (BLS) estimates an overall increase in employment of 17.5 million, or 17 percent, from 1980 to 1990. The projections include gains of 49 percent for computer programmers, 68 percent for computer systems analysts, 72 percent for computer operators, and 93 percent for data processing machine mechanics. These large percentage increases might lead you to believe that high-technology jobs really are the wave of the future. However, the low levels of current employment for these jobs, compared to other occupations, make the percentage gains deceptive. These occupations will account for only 460,000 additional jobs in 1990. Of all occupations, the four in which employment will grow the most over this period are projected by BLS to be: secretaries, nurses' aides and orderlies, janitors and sales clerks. These occupations will provide 2,188,000 new jobs — 5 times more than their "high-technology" counterparts. BLS has estimated that technical occupations, such as scientists, engineers and computer specialists, made up 3.4 percent of all occupations in 1980 and will make up 3.7 percent in 1990, hardly a tremendous jump during a 10-year period.

Another important consideration is the massive unemployment which has been generated by the economic policies and political decisions in the past three years. According to the most recent BLS figures, the ranks of the unemployed, including discouraged workers who are unemployed but have given up looking for work, number about 13 million. In addition, there are nearly 6 million workers on involuntary part-time schedules, for a total of 19 million Americans unable to find needed full-time employment. The unemployment rate is over 20 percent for black workers, teenagers, and mining and construction workers. The number of workers experiencing at least one period of unemployment during 1981 was over 23 million and the 1982 figure, not yet available, was undoubtedly higher. In addition, BLS projects that there will be an average of 1.8 million new entrants to the labor force each year from 1982 to 1990. The testimony of Henry Levin and Russell Rumberger of Stanford noted that the current level of unemployment will hinder efforts of those displaced by technology to find jobs.

We can also expect that the transfer of jobs overseas by U.S. multinational companies through direct investment, joint ventures and licensing and other agreements, will continue to affect job opportunities here. For the past 25 years, advances in technology have often been used to ease the utilization of relatively unskilled, and very poorly paid, workers around the world to provide the goods consumed by American workers. As this process is now also occurring in the service industries, the effect on available work will likely be even greater than in the past.

The picture posed so far looks rather bleak. Massive joblessness is plaguing the U.S., and Europe as well. The bulk of jobs expected to be available require very little skill and are low-paid occupations in low-paid industries. This picture stands in sharp contrast to the glorious future predicted with blind certainty by some economists and politicians. That view is reflected in the econometric analysis contained in the testimony of Professors Almon and Buckler. The "high tech" industries they expect to brighten prospects for the future, even as broadly defined by BLS, make up only 4.6 percent of American industry's employment, and the jobs requiring the extensive math and science training they say must be taught in our schools make up only about 15 percent of all jobs in even those industries. We believe that, without changes in the way new technology is introduced and in public policy dealing with employment (and unemployment), we will face a bleak rather than a bright future.

New technology will not only affect the types of new jobs that will be available in the future; it will also affect existing jobs. For industrial workers, there is the ominous possibility that there will be less skill required in many current jobs as well as new jobs, and less worker control of work than is now the case. This has been true in the past, as in the change from manual to numerical control of machine tools. The production worker traditionally set up and controlled the machine's operations, but the numerical control tape is generally made by "technical" personnel. This process has been repeated with maintenance work. When mechanical equipment is replaced by electronic machinery, a "technician" rather than a skilled-trades worker may be called on for repair work. Thus, the scope of work available to traditional industrial workers can be narrowed by the new technology and the workers' role in the production process thereby reduced. We know that this reduction in the scope of work is not an inevitable companion to the introduction of new technology. However, because of the unplanned nature of our economy and the absolute freedom of capital movement, there is no way of knowing what jobs will, in fact, be available in the future.

The prospect of a manufacturing workforce with lower skills implies lower pay as well. The gulf between production workers and the technical and engineering staffs may widen enough to become impassible and there would be no chance for advancement for the majority of workers. Computerized machinery's capacity to record and control the pace of production work creates the potential for a polarization between those with advanced skills and those without them. This same equipment allows certain work to be performed in homes and other decentralized workplaces. While this development has been welcomed by some, it creates the potential for high technology versions of all the evils traditionally associated with industrial homework.

We see these possibilities as a danger to community and regional patterns of employment and income distribution. The problems now faced by the workers in the states of the Great Lakes region are formidable and unlikely to be resolved quickly or easily. This type of dislocation could happen to other regions or communities as a result of the impact of further industrial change due, at least in part, to technological changes.

While we see these problems developing, the labor movement has not watched from the sidelines as they proceed. Unions have actively pursued the interests of their members and their communities when technological change has been a disruptive force. Bargaining objectives have included contractual provisions for advance notice, retraining, skill development, job and income security, and recall rights.

Unions have been negotiating a variety of contract provisions for workers affected by new technology for many years. In the latest Comparative Survey of Major Collective Bargaining Agreements compiled by the Industrial Union Department's Research Section and published in January 1982, nearly 25 percent of the contracts contained specific provisions for advance notice to the union when new technology is introduced, and over 10 percent required employer-provided training for a new job within the company for workers affected. Industries with such provisions ranged from autos, metal containers and steel to textiles, printing and newspapers. Since the survey was compiled, provisions in many of these contracts have been improved and other contracts have added such provisions.

Provisions for advance notice of technological change give the union the opportunity to discuss the impact of such changes on workers and their work. The current restructuring of many basic industries shows the profound effects the introduction of technology can have on the numbers of workers required, the tasks they will perform, and the skills they need. Too many firms have done too little preparation for the effects before installing new equipment. The result has been instability for the workforce and inefficiency. Advance notice, and open discussion of what is to take place with the workers and their representatives, can help make the transition to the use of new technology less difficult for the employer, while protecting the interests of the workers affected.

The training and retraining of workers displaced by new technology has become a prominent issue of public concern. Union efforts in this area have focused on employer-provided retraining for at least two reasons. First, the employer reaps a financial benefit from the introduction of technology and the replacement of workers. This financial reward, in the form of higher productivity and the related cost-saving and various tax benefits, is always behind the employer's decision to adopt new technology. It is only fair that the company share this gain to assure that its affected workers can continue to earn a living and build on their investment in skills and benefits in the employer's business. Secondly, the local or national union bargaining with a company has nowhere else to turn to obtain relevant training for its members. As the employer needs to fill jobs, the employer should provide, or pay for, the job-related training as well. If companies would share and discuss investment and new technology plans with workers and their representatives, they would find tremendous interest on the part of workers and a willingness to plan for the future.

In most cases, contract-mandated retraining is for other available work in the plant. This retraining is usually of short duration and does not significantly alter the type of work performed by the individual worker. However, when more workers are displaced than can be reemployed within the plant, the inadequacy of this type of retraining becomes clear.

Unions have proposed that work which replaces existing jobs should be performed by those now doing such tasks. In this way, workers' skills, pay and job input can grow with the sophistication of the equipment they use. Retraining of this type could cover programming of computerized manufacturing equipment and systems for work scheduling, and maintenance and repair work on all new equipment. Training could also provide workers with the skills necessary to analyze and assess the determination of work tasks and equipment design.

There is another reason to upgrade workers' skills when new technology is introduced. The full potential of industrial workers is hardly ever utilized. This limits their ability to contribute in the workplace. The computer-controlled automation currently available and now under development can take over many of the dangerous and repetitive jobs workers are now required to perform. It can also serve as a tool through which workers can increase their knowledge of the many facets of the production process and contribute to improving it. Training related to the many facets of production, not just those directly related to the workers' present job, should be available to all employees as a means of encouraging their growth both as individuals and as workers. Such broad training programs could help to reverse the impact of decades of limiting the scope of employer-designed jobs using the dated principles of scientific management.

Training is not the only area where unions have tried to influence the impact of new technology on their members. Several unions have taken steps to make this issue central to their bargaining goals. One of our affiliates, the Communications Workers of America, just announced their 1983 bargaining priorities for negotiations with the Bell System. Their demands include full protection from technological unemployment and erosion of jobs and a national Labor-Management Committee on technological change. This follows their setting up an ambitious program of skills testing and training to enable it to match available workers with the jobs of the future in the communications industry.

Perhaps the most forthright reaction has come from the International Association of Machinists and Aerospace Workers (IAM), also an affiliate of the IUD. The IAM has proposed a Technology Bill of Rights, mandating, for example, that technology improvements do not reduce jobs, improve the conditions of work and expand workers' skills and knowledge, and that cost savings be shared with workers (their document is attached).

The methods we are now using to distribute the benefits of new technology, and its related higher productivity, have proven inadequate to safeguard the employment and income security of working people. The corporate investment decisions that we rely upon to create new jobs, like the decisions that have left 13 million jobless today, are now shrouded in secrecy and not subject to social constraints. How can we assure that investn [illegible] sufficient and income distribution appropriate for generating full employment? How can we assure that new technology will result in upgrading workers' skills and increase their workplace contributions when the choices of equipment design, how much new equipment to buy, how and where to use it are all made by management with no input from the workers who will be directly affected?

These concerns explain support for plant closing legislation. Such a law would require that a company sit down with its workers and representatives of their community to prevent unnecessary plant closings, promote conversion to new lines of business and facilitate adjustment for affected workers and communities where mass layoffs cannot be prevented.

It is time to consider shortening the standard workweek to generate more jobs. While productivity has nearly tripled since passage of the Fair Labor Standards Act, the statutory workweek has remained constant at 40 hours. As Lynn Williams of the United Steelworkers of America stated in his testimony, "The labor movement always has believed that a reasonable social contract should include a full employment commitment. But that doesn't mean 40 hours a week and retirement at 65 when circumstances cry out for a lowering of those figures." Reducing the workweek would supplement efforts to shorten the work year, by extending vacations and adding holidays, and worklife, through early retirement.

A requirement that employers inform the workforce well in advance of the implementation of new technology would also prove beneficial. It would give workers a voice in determining the way the technology would affect their numbers and their jobs.

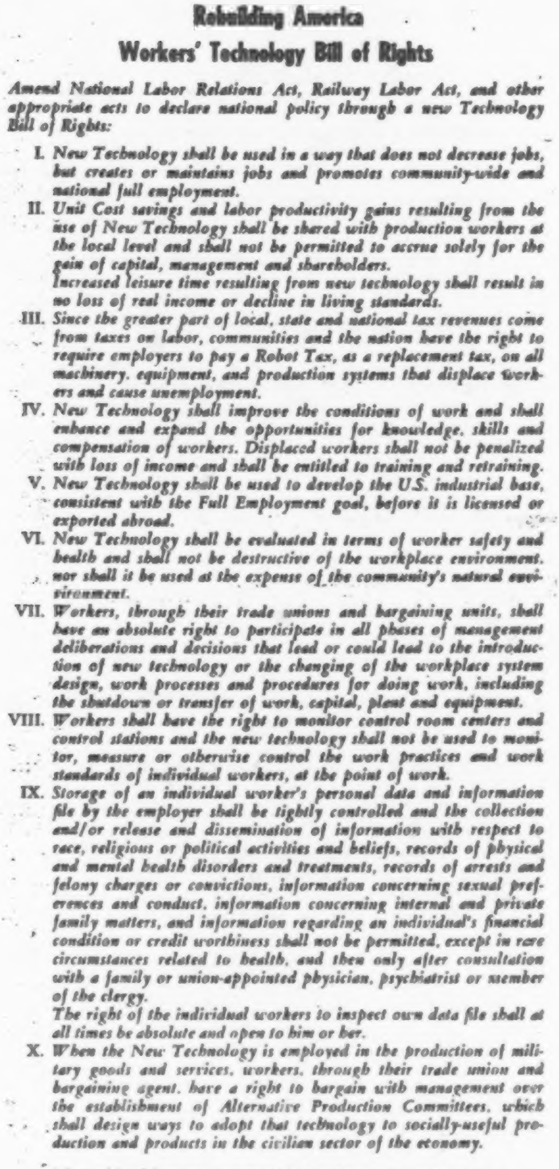
To have the new technology benefit current and future workers, management will have to inform its workers and communities of its investment plans so that national efforts for full employment and retraining can be coordinated with emerging technologies. Only in this way will working Americans be assured of benefiting from the implementation of these technologies.

Despite the hallelujahs of the crowds, new technology may prove to be an engine of disruption and discontent rather than the salvation of society. We must view the issue with more sophistication than it currently receives in the press, and with a historical perspective that includes the unemployment rates now prevailing and the types of jobs which have become available in the past and are likely to appear in the future.

BLS Projections 1980-1990
(thousands)

	Employment		Change 1980-1990	
	1980	1990 (low estimate)	Amount	Percent
Total	102,107.3	119,591.1	17,483.8	17.1%
Computer Programmers	228.2	339.9	111.7	48.9
Computer Systems Analysts	204.6	343.2	138.6	67.7
Computer Operators	184.6	316.7	132.1	71.6
Data Processing Machine Mechanics	83.0	160.4	77.4	93.2
Secretaries	2,469.0	3,168.7	699.7	28.3
Nurses' Aides, Orderlies	1,174.6	1,682.3	507.7	43.2
Janitors & Sextons	2,751.2	3,252.5	501.3	18.2
Sales Clerks	2,879.9	3,359.2	479.3	16.6

Source: Occupation Projections and Training Data, 1982 Edition (Bulletin 2202), U.S. Department of Labor, BLS.



Rebuilding America

Workers' Technology Bill of Rights

Amend National Labor Relations Act, Railway Labor Act, and other appropriate acts to declare national policy through a new Technology Bill of Rights:

I. *New Technology shall be used in a way that does not decrease jobs, but creates or maintains jobs and promotes community-wide and national full employment.*

II. *Unit Cost savings and labor productivity gains resulting from the use of New Technology shall be shared with production workers at the local level and shall not be permitted to accrue solely for the gain of capital, management and shareholders.*

Increased leisure time resulting from new technology shall result in no loss of real income or decline in living standards.

III. *Since the greater part of local, state and national tax revenues come from taxes on labor, communities and the nation have the right to require employers to pay a Robot Tax, as a replacement tax, on all machinery, equipment, and production systems that displace workers and cause unemployment.*

IV. *New Technology shall improve the conditions of work and shall enhance and expand the opportunities for knowledge, skills and compensation of workers. Displaced workers shall not be penalized with loss of income and shall be entitled to training and retraining.*

V. *New Technology shall be used to develop the U.S. industrial base, consistent with the Full Employment goal, before it is licensed or exported abroad.*

VI. *New Technology shall be evaluated in terms of worker safety and health and shall not be destructive of the workplace environment, nor shall it be used at the expense of the community's natural environment.*

VII. *Workers, through their trade unions and bargaining units, shall have an absolute right to participate in all phases of management deliberations and decisions that lead or could lead to the introduction of new technology or the changing of the workplace system design, work processes and procedures for doing work, including the shutdown or transfer of work, capital, plant and equipment.*

VIII. *Workers shall have the right to monitor control room centers and control stations and the new technology shall not be used to monitor, measure or otherwise control the work practices and work standards of individual workers, at the point of work.*

IX. *Storage of an individual worker's personal data and information file by the employer shall be tightly controlled and the collection and/or release and dissemination of information with respect to race, religious or political activities and beliefs, records of physical and mental health disorders and treatments, records of arrests and felony charges or convictions, information concerning sexual preferences and conduct, information concerning internal and private family matters, and information regarding an individual's financial condition or credit worthiness shall not be permitted, except in rare circumstances related to health, and then only after consultation with a family or union-appointed physician, psychiatrist or member of the clergy.*

The right of the individual workers to inspect own data file shall at all times be absolute and open to him or her.

X. *When the New Technology is employed in the production of military goods and services, workers, through their trade union and bargaining agent, have a right to bargain with management over the establishment of Alternative Production Committees, which shall design ways to adopt that technology to socially-useful production and products in the civilian sector of the economy.*

Adopted by delegates to 1982 IAM New Technology Conference

Mr. **Walgren**. Thank you very much for that statement.

Let's break until this vote is completed on the floor. We will come back at that point.

[Recess.]

Mr. **MacKay** [acting chairman]. On behalf of the chairman and the other members, I apologize for the delay. There are days when this schedule becomes somewhat chaotic.

If it is agreeable with you, Mr. Brinner, we will go ahead with your prepared testimony now. I feel certain that the other members will be back in time to engage in the questions and answers.

[The biographical sketch of Dr. Brinner follows:]

Roger E. Brinner

Dr. Brinner is Group Vice President and Director of DRI U.S. Economic Service, responsible with Dr. Otto Eckstein, Chairman of DRI, for all related forecasting, research, and consulting at DRI. Previous DRI experience from 1978–1983 includes the position of Chief Energy and International Economist. During this period, Dr. Brinner authored or co-authored the DRI models for Europe, U.S. Energy and World Oil. He has also been Senior Staff Economist responsible for U.S. forecasts at the Council of Economic Advisors, Director of DRI U.S. Macro Research, and Assistant Professor of Economics at Harvard University. Educational background includes a BA with honors in economics from Kalamazoo College, a MA and PhD in economics from Harvard University.

STATEMENT OF DR. ROGER E. BRINNER, GROUP VICE PRESIDENT AND DIRECTOR, U.S. ECONOMIC SERVICE, DATA RESOURCES, INC.

Dr. **Brinner**. Mr. Chairman, members of the committee and the task force, I am pleased to be given the opportunity to present my perspective on the relationship between changing technology and employment.

As you have all written to me, the issue at hand is an assessment of the extent to which emerging technological change presents a threat or offers an opportunity to American workers. Put another way, will automation destroy more jobs than it creates, and will new processes and products put severe strains on the work force as they make some skills obsolete or call for new skills which are in short supply?

Finally, do we have a choice? Can we realistically opt to slow the pace of technological change to reduce employment turnover? Would this slowing reduce unemployment or be counterproductive?

The perspective I will present today in answering these questions is an optimistic one. We are adaptive and creative citizens, by and large. Our adaptability means that our labor force is being trained and retrained, such that rough balance, not gross imbalance, should be anticipated between the skills demanded and those supplied. This is not coincidental.

The designers of new technology and products are market driven by current scarcities as they frame their new products and processes. The designers are also often implementing the required retraining for their work force because turnover is expensive for the employer as well as the employee. Perhaps the only weak link is the feedback to school systems.

Our creativity and adaptability also mean that we are reasonably well positioned to respond to our foreign competitors as they copy our old technology or develop new processes of their own. In many ways, the desirable openness of our economy indicates we do not have a choice to make. Japan, Europe, and the newly-industrializing nations need, and will use, existing technology to improve their living standards. New products and processes will prevent their gain from being our loss. The global pie will be expanded rather than merely redistributed.

If I am so optimistic, why are others concerned? Perhaps a large measure of the answer comes from two related sources. The first source may be the extent to which I believe in the adaptability of the work force. The second is the extent to which the current cyclical unemployment problem may have been misinterpreted as a secular or structural problem and perhaps then may have been blamed on technological change.

The current high unemployment is not correctly interpreted as the adverse effect of change. It derives from the OPEC oil price shocks, the domestic inflation spiral initiated in the late 1960's and early 1970's, and the "need" to cool off these price pressures through a prolonged recession. "Need" is used in the particular sense that in our economy we were unable to instantaneously adjust to an abrupt, external shock, such as the movement of oil prices from $2 to $34 per barrel in 8 years, or to an abrupt surge in domestic demand, as seen in the Vietnam era.

The oil price shock required us to either use much less energy or to sell many more of our goods to the oil producers in return for the same amount of oil. Our cars, houses, and factories couldn't be immediately changed to use less oil. OPEC's appetite for our goods took 5 years to match its income. And we only belatedly accepted a general reduction in our real return for an hour worked or a dollar invested in exchange for higher living standards in the energy-rich nations. These "failures" of adaptation explain our unemployment today, not a hypothetical failure of our work force to adapt to, or be retrained for, emerging technology.

There is good evidence to support the claims that technology creates jobs. In earlier research, I concluded that high technology industries expanded at a 5.6 percent compound rate from 1950 to 1978 versus 2.7 for low technology industries. Over this same time span, output per employee hour increased 3.3 percent in advanced industries, only 2.3 percent in traditional activities.

The favorable labor productivity record is mirrored in the price record: 2.5 percent annual inflation in high technology versus 3.4 percent in low technology firms.

The gains in output per worker were not at the expense of employment. The employee hour gains of rapidly modernizing industries surpassed their conservative counterparts by a sixfold margin: 2.3 percent versus 0.4 percent. The enhanced domestic and international competitive posture of the advanced industries generated more than enough demand to expand employment at a fast pace.

Advanced industries generate innovative products for which there are high-growth markets at home and abroad. This product demand leads these firms to attract workers from other sectors of the economy, employing them in more productive occupations.

High technology industries can be argued to have a significant impact on employment due to their contribution to price stability.

It is unquestionably easier for policymakers to counter recessionary shocks if they are not simultaneously challenged to curb inflation. As I noted earlier, the price record of industries with strong R&D effort is clearly superior to those with weak research efforts. Thus, indirect cyclical benefits enhance the more obvious long-run gains.

The indirect benefits of new processes are not entirely captured by the firms or industries in which they originate. The reduced costs spill over through competitive pressures into lower prices to the other sectors buying the output of the innovating industry. This makes national inflation lower and makes domestic production more defensible versus foreign competition. Even if the exchange rate appreciates in response, this appreciation gives the United States the opportunity for a higher living standard through more favorable terms of trade. This gain is equivalent to the gain described earlier for OPEC when oil prices increased.

How attractive are the investment opportunities and the national rewards for embracing change? The hot stock market for high-tech firms certainly indicates there are attractive micro opportunities. But the net national return is also above average. For example, the private rate of profit derived from R&D expenditures is substantially above the return on traditional investments. It is near 15 to 20 percent beyond inflation. The private return to the firm initially sponsoring the research is only a fraction—perhaps one-third to two-thirds—of the total return received by the economy. The extra social return is the signal that tax initiatives are needed to bring R&D activity up to an optimal level.

Through further analysis, the social and private return combined has been estimated to be as high as 35 percent. The margin between the total return and the private return reflects the spillover benefits enjoyed by society at large.

As I read through the testimony presented in earlier panels, I believe I found sentiments similar to mine, backed up by substantial detail.

Joel Hirschhorn explains the drop in employment in the steel industry on the basis of global recession and competition. The technological advances which the steel industry has adopted are defensive measures which protected domestic output and employment from even greater losses. I think this is in line with the testimony that the Congressman presented at the beginning of this panel. High technology is not a threat. It is a promise. It is a defense.

Clopper Almon and Margaret Buckler make the cogent point that: "Our present 10.1 percent unemployment rate, coming after a decade of almost zero aggregate productivity increase, cannot be blamed upon automation."

Patricia Hogue sees robotics as displacing very few older workers. They will be retrained. Her concern is the balance of skills held by young workers relative to market demands: the potentially weak feedback link I cite to the school system.

Finally, Audrey Freedman comments that the baby boom has turned into the "prime age boom," and these individuals "may be especially adaptable to job change, industry change."

With this relatively optimistic perspective, the appropriate role of Government is to remain on the current course of supportive tax treatment for fixed and R&D investment and trade-related, employment-adjustment assistance, while investigating the adequacy of the feedback of skill requirements to the school system.

Perhaps, collaborative training programs at school and on the job and equipment donations deserve more favorable tax treatment to reflect their spillover benefits.

Thank you for the privilege of presenting this testimony.

[The prepared statement of Dr. Brinner and supplementary material follow:]

Statement Prepared

by

Dr. Roger E. Brinner
Group Vice President and Director
U.S. Economic Service
Data Resources, Inc.

TECHNOLOGY AND EMPLOYMENT:
FUTURE CONSIDERATIONS

Mr. Chairman, I am pleased to be given the opportunity to present my perspective on the relationship between changing technology and employment. I have a compact, issue-oriented presentation here and have supplied copies of my background, quantitative analysis for the record.

The issue at hand is an assessment of the extent to which emerging technological change represents a threat or offers an opportunity to American workers. Put another way, will automation destroy more jobs than it creates, and will new processes and products put severe strains on the workforce as they make some skills obsolete while calling for new skills in short supply? Finally, do we have a choice? Can we realistically opt to slow the pace of technological change to reduce employment turnover, and would this slowing reduce unemployment or be counterproductive?

The perspective I will present today in answer to these questions is an optimistic one. We are adaptive and creative citizens by and large. Our adaptability means that our labor force is being trained and retrained such that rough balance, not gross imbalance, should be anticipated between the skills demanded and those supplied. This is not coincidental--the designers of new technology and products are market-driven by current scarcities as they frame their new products and processes. The designers are also often implementing the required retraining for their workforce because turnover is expensive for the employer as well as the employee. Perhaps the only weak link is the feedback to school systems.

Our creativity and adaptability also mean we are reasonably well positioned to respond to our foreign competitors as they copy our old technology or develop new processes of their own. In many ways, the desirable openness of our economy indicates we do not have a choice to make--Japan, Europe and the newly industrializing nations need and will use existing technology to improve their living standards. New products/processes will prevent their gain from being our loss. The global pie will be expanded rather than merely redistributed.

If I am so optimistic, why are others concerned? Probably a large measure of the answer comes from two related sources. The first source may be the extent to which I believe in the adaptability of the work force. The second is the extent to which the current cyclical unemployment problem may have been misinterpreted as a secular or structural problem and perhaps then may have been blamed on technological change.

Adaptability cannot be easily measured or imagined. Therefore it may be tempting to cite a robot which can replace ten workers, to fail to see where else the workers' current skills are useful or how they are fungible, and then to ascribe rising unemployment to technological change. But this has never been a reasonable description of the link between change and jobs. Across nations, across time, and across industries, rapid productivity growth has consistently meant faster income growth without an adverse impact on employment in the aggregate. New techniques are market-driven. They respond to change as well as creating it. For example, new farming techniques allowed one man to feed many more, thus opening up the possibility for the others to participate in the manufacturing jobs opening up in the Industrial Revolution. Higher wages in manufacturing drew more workers and stimulated the need for further farm productivity advances.

The current high unemployment is not correctly interpreted as the adverse effect of change. It derives from the OPEC oil price shocks, the domestic inflation spiral initiated in the late 1960s and early 1970s, and the "need" to cool off these price pressures through a prolonged recession. "Need" is used in the particular sense that we could not instantaneously adjust to an abrupt, external shock such as the movement of oil prices from $2 to $34 per barrel in eight years or to an abrupt surge in domestic demand as seen in the Viet Nam era.

The oil price shock required us to either use much less energy or to sell many more of our goods to the oil producers in return for the same amount of oil. Our cars, houses, and factories couldn't be immediately changed to use less oil. OPEC's appetite for our goods took five years to match its income. And we only belatedly accepted a general reduction in our real return for an hour worked or a dollar invested in exchange for higher living standards in energy-rich nations. These "failures" of adaptation explain our unemployment today, not a hypothetical failure of our workforce to adapt to or be retrained for emerging technology.

Historical Evidence

There is good evidence to support the claims that technology creates jobs. In earlier research on the impact of new products and processes, I concluded:

> An analysis of output, employment, and price behavior in manufacturing industries over the past three decades indicates that "high-technology" industries have surpassed "low-technology" industries according to all meaningful aggregate economic indicators. The score reads:
>
> . **Real Growth**: High-technology industries expanded at a 5.6% compound rate from 1950 to 1978 versus 2.7% for low-technology industries. This growth differential has moved the high technology sector from 42% of the output of the low technology sector to 91%.
>
> . **Productivity**: Over the same time-span, output per employee hour increased 3.3% in advanced industries, only 2.3% in traditional activities.
>
> . **Inflation**: The favorable labor productivity record is mirrored in the price record: 2.5% annual inflation in high-technology versus 3.4% in low technology firms.
>
> . **Employment**: The gains in output per worker were not at the expense of employment. The employee hour gains of rapidly modernizing industries surpassed their conservative counterparts by a six-fold margin: 2.3% versus 0.4%. The enhanced domestic and international competitive posture generated more than enough demand to expand employment at a fast pace.
>
> Advanced industries generate innovative products for which there are high-growth markets at home and abroad. This product demand leads these firms to attract workers from other sectors of the economy, employing them in more productive occupations. If the economy is near full employment, high-technology industries primarily perform the function of

reallocating labor to more effective uses, rather than expanding national employment; if slack does exist in the job market, the growth industries can be expected to increase domestic employment.

Second, high-technology industries can be argued to have a significant, additional impact on employment due to their contribution to price stability. It is unquestionably easier for macro policymakers to counter recessionary shocks if they are not simultaneously challenged to curb inflation. As noted earlier, the price record of industries with strong research and development effort is clearly superior to those with weak research efforts. Thus, indirect cyclical benefits enhance the more obvious long-run gains.[1]

The indirect benefits of new processes are not entirely captured by the firms or industries in which they originate. The reduced costs spill over through competitive pressures into lower prices to the other sectors buying the output of the innovating industry. This makes national inflation lower and makes domestic production more defensible versus foreign competition. Even if the exchange rate appreciates in response, this appreciation gives the U.S. the opportunity for a higher living standard through more favorable terms of trade. This gain is equivalent to the gain earlier described for OPEC as oil prices increased.

How attractive are the investment opportunities and the national rewards for embracing change? The hot stock market for "high-tech" firms certainly indicates there are attractive "micro" opportunities. But the net national return is also above average. For example, my own analysis and that of others evaluating the profitability of research and development (R&D) spending indicate:

- The private rate of profit derived from R&D expenditures is substantially above the return on traditional investments. Conceptual and data limitations make any precise estimate hazardous, but a "ball park" figure near 15% to 20% emerges from investments. Each of these returns is the real return beyond coverage of ongoing inflation.
- The private return to the firm initially sponsoring the research is only a fraction--perhaps one-third to two-thirds--of the total return

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[1] Brinner, Roger E., "The Proper Medicine for Staglation," Technology in Society, Vol. 3, pp. 46,51.

> received by the economy. The extra social return is the signal that tax initiatives are needed to bring R&D activity up to an optimal level.

Through further analysis at the macroeconomic level, the social plus private rate of return has been estimated to be as high as 35%. The margin between the total return and the private return reflects the spillover benefits not appropriable by the sponsoring firm.[2]

Summary

As I read through the testimony presented in Panels #1 through #7, I believe I found sentiments similar to mine, backed up by substantial detail.

Joel Hirschhorn explains the drop in employment in the steel industry on the basis of global recession and competition. The technological advances which the steel industry has adopted are defensive measures which protected domestic output and employment from even greater losses.

Clopper Almon and Margaret Buckler make the cogent point that: "Our present 10.1 percent unemployment rate, coming after a decade of almost zero aggregate productivity increase, cannot be blamed upon automation."

Patricia Hogue sees robotics as displacing very few older workers--they will be retrained. Her concern is the balance of skills held by young workers relative to market demands: the weak feedback link I cite to the school system.

Audrey Freedman comments that the baby boom has turned into the "prime age boom" and these individuals "may be especially adaptable to job change, industry change..."

With this relatively optimistic perspective, the appropriate role of government is to remain on the current course of supportive tax treatment for fixed and R&D investment and trade-related and employment adjustment assistance, while investigating the adequacy of the feedback of skill requirements to the school system. Perhaps collaborative training programs and equipment donations deserve more favorable tax treatment to reflect their spillover benefits. In an era of $200 billion Federal budget deficits, I assume the absence of a designated crisis and a related call for expenditures and tax relief is welcome to your ears.

Again, let me thank you for the privilege of presenting this testimony.

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[2] Ibid., p. 53.

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The Proper Medicine for Stagflation

Roger E. Brinner

Inflation is the undisputed entry at the top of the list of national economic problems. Indeed, the other possible contender — high unemployment — is fundamentally due to the current need for a low-pressure economy to cool off inflation. The overwhelming consensus prescription to reverse the upward ratcheting inflation of the 1970s is strong capital spending, and Democrats and Republicans were headed toward a "supply-side" tax cut skewed toward direct business investment stimulus until the Reagan Administration initiatives surfaced. Now confrontation is possible in two areas. The first conflict looms between the consensus view just described and the *new* "supply-siders" who hope for productivity gains born of greater work effort and personal savings in response to tax cuts skewed toward personal, not business, taxation.

The second threatened conflict is between fiscal and monetary policy. The Reagan proposal for a three-year sequence of large-scale tax cuts could not be matched with equivalent expenditure cuts. The resultant fiscal stimulus would create income and hence credit growth beyond the bounds sought by the Federal Reserve, yielding a credit crunch with a pronounced negative impact on investment. The two dimensions of the emerging conflict are thus the composition of the tax cut — focusing on business versus personal tax reduction — and the size of the tax cut.

Perhaps the Reagan-team enthusiasm for the radical personal tax cuts can be traced to an almost desperate desire to try something different to bring the economy out of its nagging stagflation. This essay will argue that a sharp change of tactics is in fact necessary, but that the proper strategy is a combination of strong tax incentives to support technology development and a tight-fiscal/low-interest-rate policy stance to raise the investment share of GNP. The technology initiative proposed here — a large tax credit for Research and Development (R&D) — is the only option which can simultaneously cut inflation and promote

Roger E. Brinner is Vice President and Group Director of the International and Energy Division of Data Resources, Inc. He has been Assistant Professor of Economics at Harvard University and Senior Staff Economist responsible for macroeconomic analysis at the Council of Economic Advisers and has directed Data Resources' long-term economic analysis. Dr. Brinner has had numerous essays and articles published in the areas of capital formation, tax policy, inflation, and general macroeconomic forecasting.

employment. Given the Federal Reserve's conservative money growth targets, tight fiscal policy is a necessity to keep interest rates low and credit available to finance business fixed capital.

The Necessity of Strong Research and Development Spending

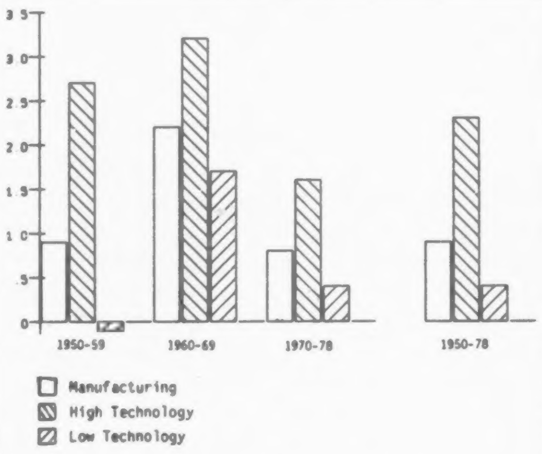
R&D is the only possible way to generate the knowledge and flexibility required for a business, or indeed a national economy, to progress and to stay competitive. This postulate has been inadequately recognized in the past by business and government, but the failure of US enterprises to cope fully with the shocks of the 1970s has led to analysis which should generate the necessary awareness of the role of R&D. US labor productivity growth has collapsed. The country's share of international trade has fallen as its reputation for product leadership has been successfully challenged in automobiles, electronics and elsewhere. These problems will not solve themselves. They will get progressively worse in a world where the US' major competitors already recognize the need to shift resources rapidly out of lagging sectors and into developing, high-technology sectors. Japan, Germany and France are subsidizing and sponsoring this transformation process within their countries. The US cannot afford to lag behind, or a weak dollar and declining living standards relative to the industrial world will ensue. The US can afford to provide strong tax incentives to boost research. In the short run, these must be provided at the expense of otherwise desirable personal tax cuts; in the long run, these tax incentives will prove to be a solid investment.

The Impact of Technology on Industrial Performance

An analysis of output, employment, and price behavior in manufacturing industries over the past three decades indicates that "high-technology" industries have surpassed "low-technology" industries according to all meaningful aggregate economic indicators. The score reads:

- *Real Growth:* High-technology industries expanded at a 5.6% compound rate from 1950 to 1978 versus 2.7% for low-technology industries. This growth differential has moved the high technology sector from 42% of the output of the low technology sector to 91%.
- *Productivity:* Over the same time-span, output per employee hour increased 3.3% in advanced industries, only 2.3% in traditional activities.
- *Inflation:* The favorable labor productivity record is mirrored in the price record: 2.5% annual inflation in high-technology versus 3.4% in low technology firms.
- *Employment:* The gains in output per worker were not at the expense of employment. The employee hour gains of rapidly modernizing industries surpassed their conservative counterparts by a six-fold margin: 2.3% versus 0.4%. The enhanced domestic and international competitive posture generated more than enough demand to expand employment at a fast pace.

Figure 1 and Table 1 compare the employment growth rates of the high- and low-technology sectors.[1] The high-technology sector has a clear margin of superiority over the low-technology industries. These results are confirmed for the



INDUSTRY	1978* Level	1950-59	1960-69	1970-58	1950-78
Manufacturing	39.2	0.9	2.2	0.8	0.9
High Technology	14.0	2.7	3.2	1.6	2.3
Low Technology	21.5	-0.1	1.7	0.4	0.4

*Billions of hours, full and part-time workers.

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*In Charts 1 through 4 and the accompanying supplementary tables the growth rates for the sub-intervals may not appear to be consistent with the full interval in selected cases. In fact, they are fully consistent. The sub-interval for 1950-59 presents the rate of increase from the 1950 level to the 1959 level and the sub-interval for 1960-69 from the 1960 level to the 1969 level. Thus, the 1959-60 and 1969-70 individual years are not captured in the sub-intervals but are included in the full 1950-1978 interval.

FIGURE 1. Compound Annual Growth Rate of Employee Hours.

shorter subintervals, and when the disaggregation is extended further to the three-digit, SIC-code level. The contrasts are equally clear when labor productivity increases are examined (Figure 2 and Table 2). The trend rate of increase in real output per employee of 2.5% per year for all manufacturing was led by 3.3% per year in high-technology industries. The manufacturing average was substantially depressed by the 2.3% improvement in labor productivity in industries with low research efforts.

The aggregate effect of increases in employment and productivity is reflected, by definition, in the rate of real growth of high-technology industries (Figure 3 and Table 3). The new products of advanced research have a ready market at home and abroad. For example, capital equipment embodying advanced technology is a leading US export sector, permitting the US to import necessary raw materials to enhance the living standard of its trading partners and itself.

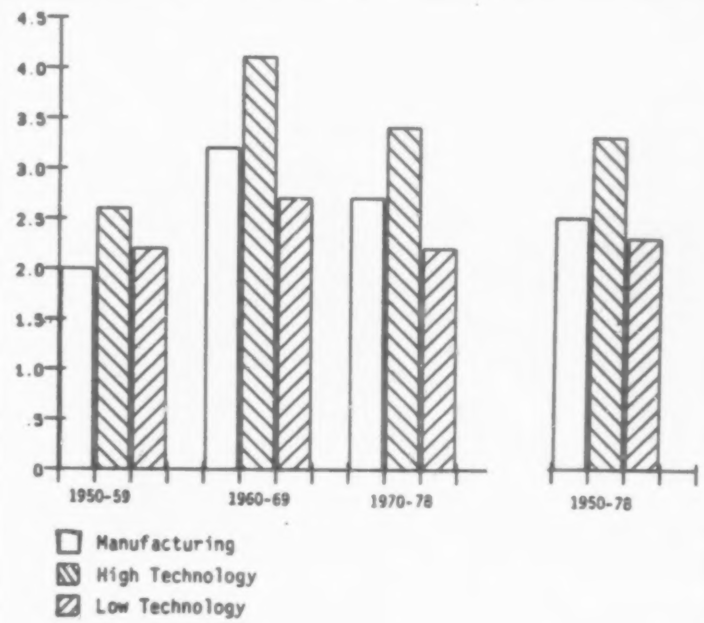
TABLE 1. Supplementary Detail 1: Compound Annual Growth Rate of Employee Hours

	Average Growth Rates				
	1978 Level*	1950–59	1960–69	1970–78	1950–78
Manufacturing	39.2	0.9	2.2	0.8	0.9
High Technology					
Professional and Scientific Instruments	2.1	2.8	2.6	0.8	2.0
Electrical Equipment (incl. Communications Equip.)	4.6	1.8	3.8	2.2	2.2
Communications Services	3.8	3.9	3.2	1.2	2.5
Chemicals	1.2	4.3	3.2	2.8	3.0
Nonelectrical Machinery (incl. Computers)	2.3	1.6	2.7	1.1	2.0
Low Technology					
Rubber and Plastic Products	0.9	2.5	−0.6	6.4	2.0
Petroleum Refining	1.5	2.3	5.4	2.6	2.9
Petroleum Extraction	0.9	−0.6	1.3	0.4	0.2
Stone, Clay and Glass	3.3	−0.3	0.1	−0.7	−0.3
Paper and Allied Products	1.8	−2.9	1.3	−1.0	−1.2
Primary Metals	2.4	0.2	1.7	−0.1	0.3
Fabricated Metal Products	1.5	−1.8	0.9	1.1	−0.3
Food and Kindred Products	1.0	−0.1	2.7	1.6	0.9
Textiles	1.4	1.9	2.1	−0.1	1.1
Apparel	1.4	1.1	1.1	0.7	0.8
Lumber and Wood Products	2.3	−0.5	1.5	−0.2	0.0
Furniture and Fixtures	3.2	1.3	3.5	0.8	1.4
Memo: Other Sectors and Categories					
Durable Manufactures	23.6	1.5	2.7	1.2	1.4
Motor Vehicles	2.0	−2.0	2.6	3.3	0.7
Aerospace & Misc. Transportation Equip.	1.9	9.7	2.5	−0.5	2.7
Nondurable Manufactures	15.6	0.2	1.5	0.1	0.4
Mining	1.8	−2.2	−0.7	4.3	0.2
Service	28.4	2.3	3.2	3.3	2.9
Finance, Insurance, Real Estate	8.4	3.4	3.2	3.1	3.2

*Billions of hours worked by full and part-time employees.

Finally, an examination of the sectors also yields strong evidence that high-technology industries have shown increases in employment while curbing inflation (Figure 4 and Table 4). High-technology industries generated inflation averaging only 2.5% per year, while prices in the low sector increased at a 3.4% pace for the entire 1950–1978 timespan. The margin of superiority increased in each decade.

To classify industries into technological strata, an "index of research effort" (IRE) was created, equal to the average ratio of research and development expenditures to gross product originating in the industry. A natural grouping suggested



INDUSTRY	1978* Level	1950-59	1960-69	1970-78	1950-78
Manufacturing	8.7	2.0	3.2	2.7	2.5
High Technology	11.0	2.6	4.1	3.4	3.3
Low Technology	7.9	2.2	2.7	2.1	2.3

*Real output per hour: output valued at 1972 prices.

FIGURE 2. Compound Annual Growth Rate of Real Output Per Employee Hour (1972 Prices).

itself such that industries with an IRE of .06 or better were termed "high technology"; those industries with an IRE below 0.6 were designated as "low technology."

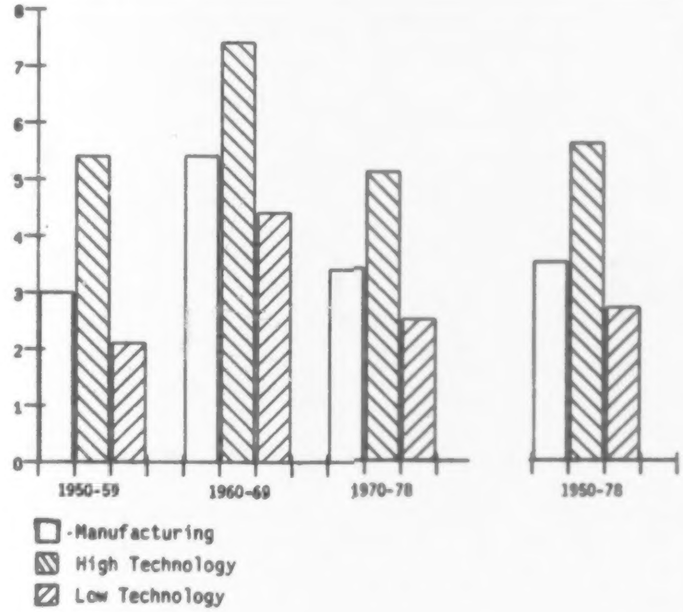
National Science Foundation (NSF) data are available at a reasonable level of disaggregation for total research and development spending by industry, and the Bureau of Economic Analysis provides corresponding data on real and nominal product, prices, and employment. Table 5 presents the index of effort by industries at a two-digit, SIC-code level of disaggregation. Examination of these ratios suggested the indicated breakdown into "high" and "low" technology. The line between high and low technology was defined to be .06, slightly below the .07 average ratio of research and development expenditures to output for all of manufacturing.[2]

TABLE 2. Supplementary Detail 2: Compound Annual Growth Rate of Real Output Per Employee Hour (1972 Prices)

	Average Growth Rates				
	1978 Level*	1950–59	1960–69	1970–78	1950–78
Manufacturing	8.7	2.0	3.2	2.7	2.5
High Technology					
Professional and Scientific Instruments	12.1	3.5	4.8	3.1	3.5
Electrical Equipment (incl. Communications Equip.)	8.3	1.1	1.9	1.1	1.5
Communications Services	8.7	3.1	5.8	3.3	4.0
Chemicals	7.8	2.6	4.0	1.3	2.4
Nonelectrical Machinery (incl. Computers)	20.7	5.2	4.9	6.8	5.4
Low Technology					
Rubber and Plastic Products	14.9	1.3	3.7	−4.8	0.6
Petroleum Refining	7.8	2.1	3.2	2.3	2.2
Petroleum Extraction	7.2	3.5	2.7	4.4	3.2
Stone, Clay and Glass	9.8	3.0	3.1	3.3	3.1
Paper and Allied Products	5.6	4.4	5.4	3.3	4.5
Primary Metals	5.1	1.4	1.8	4.7	2.6
Fabricated Metal Products	7.1	3.0	5.4	1.2	3.4
Food and Kindred Products	5.2	1.6	2.0	2.3	1.6
Textiles	9.0	0.8	3.0	4.0	2.1
Apparel	8.1	1.8	2.2	2.3	1.8
Lumber and Wood Products	8.5	0.3	1.6	0.0	0.5
Furniture and Fixtures	7.3	1.9	2.3	1.6	1.8
Memo: Other Sectors and Categories					
Durable Manufactures	8.6	1.4	3.1	2.3	2.1
Motor Vehicles	17.4	1.5	4.4	6.6	3.5
Aerospace & Misc. Transportation Equip.	7.1	1.0	3.0	−0.9	1.5
Nondurable Manufactures	8.8	2.9	3.2	3.2	3.0
Mining	11.6	4.5	3.7	−3.0	1.9
Service	6.0	1.1	1.2	0.5	0.9
Finance, Insurance, Real Estate	25.8	1.4	1.1	1.3	1.2

*Dollars of real output per employee hour, 1972 prices.

In theory, monetary and fiscal policy should be able to keep the economy on a relatively full-employment path, buffering outside shocks to keep long-run employment growth approximately equal to expansion in the labor force. If reality followed theory, the creation and adoption of high technology would have no impact on aggregate job creation: the sole role of new technology would be the enhancement of per capita living standards. However, even casual observation of economic history suggests substantial employment benefits from new products and processes.



INDUSTRY	1978* Level	1950-59	1960-69	1970-78	1950-78
Manufacturing	341.6	3.0	5.4	3.4	3.5
High Technology	152.9	5.4	7.4	5.1	5.6
Low Technology	168.5	2.1	4.4	2.5	2.7

*Billions of dollars using 1972 prices.

FIGURE 3. Compound Annual Rate of Growth Of Real Output (1972 Prices).

Advanced industries generate innovative products for which there are high-growth markets at home *and* abroad. This product demand leads these firms to attract workers from other sectors of the economy, employing them in more productive occupations. If the economy is near full employment, high-technology industries primarily perform the function of reallocating labor to more effective uses, rather than expanding national employment; if slack does exist in the job market, the growth industries can be expected to increase domestic employment.

Second, high-technology industries can be argued to have a significant, additional impact on employment due to their contribution to price stability. It is unquestionably easier for macro policymakers to counter recessionary shocks if they are not simultaneously challenged to curb inflation. As noted earlier, the price record of industries with strong research and development effort is clearly superior to those with weak research efforts. Thus, indirect cyclical benefits enhance the more obvious long-run gains.

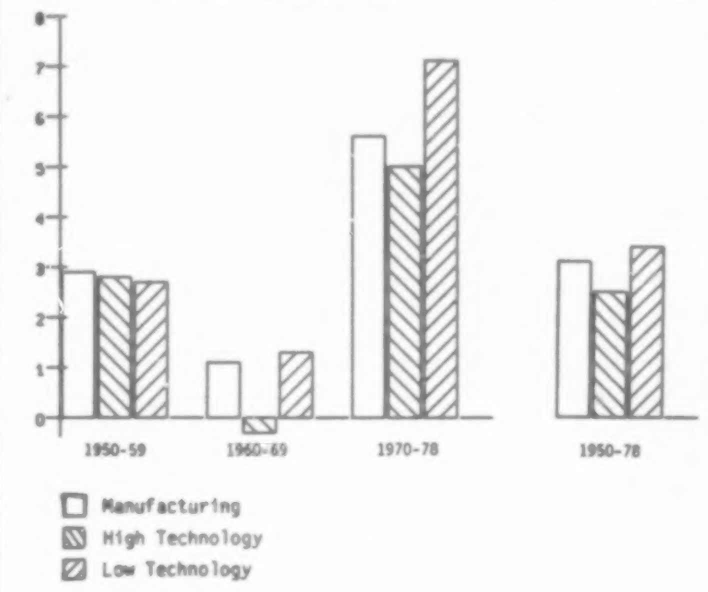
TABLE 3. Supplementary Detail 3: Compound Annual Rate of Growth Of Real Output (1972 Prices)

	Average Growth Rates				
	1978 Level*	1950–59	1960–69	1970–78	1950–78
Manufacturing	341.6	3.0	5.4	3.4	3.5
High Technology					
Professional and Scientific Instruments	25.5	6.3	7.5	3.9	5.6
Electrical Equipment (incl. Communications Equip.)	37.7	3.0	5.9	3.4	3.8
Communications Services	32.6	7.1	9.3	4.6	6.5
Chemicals	9.7	7.0	7.3	4.1	5.5
Nonelectrical Machinery (incl. Computers)	47.4	6.9	7.7	8.0	7.5
Low Technology					
Rubber and Plastic Products	13.5	3.8	3.1	1.2	2.6
Petroleum Refining	11.4	4.4	8.8	4.9	5.2
Petroleum Extraction	6.2	2.9	4.0	4.9	3.4
Stone, Clay and Glass	32.3	2.7	3.2	2.6	2.8
Paper and Allied Products	10.1	1.4	6.8	2.2	3.3
Primary Metals	12.3	1.7	3.6	4.6	3.0
Fabricated Metal Products	10.6	1.1	6.4	2.3	3.0
Food and Kindred Products	5.0	1.5	4.8	3.8	2.5
Textiles	12.5	2.7	5.2	3.9	3.3
Apparel	11.2	2.9	3.3	3.1	2.6
Lumber and Wood Products	20.0	−0.2	3.2	−0.2	0.5
Furniture and Fixtures	23.5	3.1	5.8	2.4	3.2
Memo: Other Sectors and Categories					
Durable Manufactures	203.8	2.9	5.8	3.5	3.5
Motor Vehicles	34.2	−0.5	7.1	10.1	4.2
Aerospace & Misc. Transportation Equip.	13.2	10.8	5.6	−1.3	4.2
Nondurable Manufactures	137.8	3.1	4.8	3.3	3.5
Mining	20.8	2.1	3.0	1.1	2.1
Service	169.1	3.4	4.4	3.9	3.8
Finance, Insurance, Real Estate	216.1	4.8	4.3	4.4	4.4

*Billions of dollars of real output, 1972 prices.

Quantifying the R&D Impact on Overall Activity

It is important to recognize that the favorable price behavior of high-technology industries is *not* an inevitable result of rapid increases in *labor* productivity: costs for fixed capital and R&D expenses must also be met. However, the rate of return has clearly been sufficiently large to keep total cost increases at a minimum and thus hold price increases to very low annual rates in industries sustaining their investment and development activities.



INDUSTRY	1950-59	1960-69	1970-78	1950-78
Manufacturing	2.9	1.1	5.6	3.1
High Technology	2.8	0.3	5.0	2.5
Low Technology	2.7	1.3	7.1	3.4

FIGURE 4. Compound Annual Rate of Growth of Prices.

Numerous economists have sought to quantify the rate of return to research and development expenditures. A small data base and the absence of an observable "capital stock" of accumulated knowledge have precluded precise estimation, but a consensus appears to exist on the following points:[3]

- The private rate of profit derived from R&D expenditures is substantially above the return on traditional investments. Conceptual and data limitations make any precise estimate hazardous, but a "ball park" figure near 15 to 20% emerges from investments. Each of these returns is the *real* return beyond coverage of ongoing inflation.
- The private return to the firm initially sponsoring the research is only a fraction – perhaps one-third to two-thirds – of the total return received by the economy. The extra social return is the signal that tax initiatives are needed to bring R&D activity up to an optimal level.

Through further analysis at the macroeconomic level, the social plus private rate of return has been estimated to be as high as 35%.[4] The margin between the total

TABLE 4. Supplementary Detail 4: Compound Annual Rate of Growth of Prices

	Average Growth Rates			
	1950–59	1960–69	1970–78	1950–78
Manufacturing	2.9	1.1	5.6	3.1
High Technology				
Professional and Scientific Instruments	1.3	−1.2	5.3	1.6
Electrical Equipment (incl. Communications Equip.)	4.0	2.3	6.7	4.1
Communications Services	1.7	−1.5	5.2	1.6
Chemicals	4.0	1.2	4.9	3.2
Nonelectrical Machinery (incl. Computers)	1.9	0.6	3.1	1.8
Low Technology				
Rubber and Plastic Products	1.8	0.0	15.2	4.7
Petroleum Refining	3.7	0.5	4.8	2.9
Petroleum Extraction	1.0	1.3	5.0	2.3
Stone, Clay and Glass	2.0	1.4	4.0	2.4
Paper and Allied Products	−1.1	−0.4	4.4	0.8
Primary Metals	1.7	2.7	2.2	2.2
Fabricated Metal Products	1.4	1.0	10.3	3.3
Food and Kindred Products	3.0	2.4	4.6	3.4
Textiles	3.7	1.0	5.7	3.5
Apparel	3.8	1.4	6.8	3.7
Lumber and Wood Products	5.6	1.8	9.8	5.4
Furniture and Fixtures	2.4	2.1	7.5	3.8
Memo: Other Sectors and Categories				
Durable Manufactures	3.6	1.2	6.3	3.5
Motor Vehicles	3.9	0.0	2.0	2.0
Aerospace & Misc. Transportation Equip.	4.0	1.8	7.0	4.0
Nondurable Manufactures	2.0	0.9	4.7	2.5
Mining	1.1	−0.1	14.2	4.4
Service	4.1	4.2	7.2	5.0
Finance, Insurance, Real Estate	3.7	2.7	5.3	3.8

return and the private return reflects the spillover benefits not appropriable by the sponsoring firm. Patents and licensing agreements are imperfect, and some research needs further development which the initial firm does not choose to pursue, yet which is followed up by other firms.

The relatively high return implies that the sharply declining share of GNP devoted to R&D from the mid-1960s until recently has had, and will continue to have, a serious negative impact on aggregate productivity growth and inflation. During the past two decades, R&D has contributed 0.3% per year to full-employment, capacity growth. Unfortunately, a 0.2% deterioration has been apparent in each successive five-year interval, such that the contribution has fallen from 0.63% in the 1955–1960 interval to 0.05% in the 1970–1975 interval. Table 6 presents the historical record on R&D spending and its contribution to growth.

TABLE 5. Research Effort by Industry

Class	Industry Activity		Index of Research Effort (IRE)
High	Professional and Scientific Instruments	(SIC 38)	.106
	Electrical Equipment	(SIC 36, 48)	.097
	Chemicals	(SIC 28)	.093
	Nonelectrical Machinery (incl. Computers)	(SIC 35)	.060
Low	Rubber and Plastic Products	(SIC 30)	.032
	Petroleum Refining and Extraction	(SIC 39, 13)	.025
	Stone, Clay and Glass	(SIC 32)	.018
	Paper and Allied Products	(SIC 26)	.016
	Primary Metals	(SIC 33)	.013
	Fabricated Metal Products	(SIC 34)	.012
	Food and Kindred Products	(SIC 20)	.008
	Textiles and Apparel	(SIC 22, 23)	.003
	Lumber, Wood Products and Furniture	(SIC 24, 25)	.003

TABLE 6. R&D Contribution to Growth: 1955–1975*

	%1955–60	%1960–65	%1965–70	%1970–75
Annual Growth Rates				
Real R&D Spending	9.3	5.5	1.1	−1.4
Real R&D Capital	10.2	7.1	4.1	0.8
Contribution of R&D to Real Output Growth Rates**	0.63	0.44	0.25	0.05

*The historical data are drawn from John Kendrick's compilation of R&D data in *The Formation and Stocks of Total Capital*, National Bureau of Economic Research, New York, 1976. The data on R&D investment and capital used are drawn from Tables B-5, B-23 and C-3. Kendrick's applied R&D net capital stock for 1955–1969 was extended through 1973 based on Table C-3 investment data for an estimated, econometric relation between the earlier investment and capital data. Kendrick's basic research investment series was used to construct a corresponding capital stock by arbitrarily assuming a 10% proportional depreciation rate. Kendrick assumes no depreciation or obsolescence in his series. The total stock equals the sum of Kendrick's applied R&D stock plus the adjusted basic research stock.

**The real output contribution equals the growth of the R&D "stock" multiplied by the estimated output elasticity, .062.

To highlight the future implications of research activities, three alternative forecasts were made of R&D spending for the 1982 through 1995 period.[5] The baseline is approximately equal to NSF projections of 3% real growth in R&D spending each year through 1990.[6] The pessimistic scenario assumes real R&D spending as constant. In the optimistic case, real R&D spending expands sharply to regain its 1964 peak share of real output. Growth is then sustained at 3% from 1988–1995 to match real GNP growth and thus to maintain this share. Table 7 presents the R&D contibution to growth under each of these alternatives.

The baseline future projection implies an average contribution of 0.13% per

TABLE 7. The R&D Contribution to Growth: Alternative Forecasts to 1990

Annual Growth Rates	%1980–1985	%1985–1990	%1990–1995
R&D Spending (The Current Flow)			
Baseline	3.4	3.0	3.0
Optimistic	9.0	5.9	3.0
Pessimistic	1.0	0.0	0.0
R&D Capital (The Accumulated Stock of Past Spending)			
Baseline	1.0	2.4	2.9
Optimistic	2.9	6.7	4.7
Pessimistic	0.2	0.2	0.05
Contribution of R&D to Potential Output Growth Rate:*			
Baseline	0.06	0.15	0.18
Optimistic	0.18	0.42	0.30
Pessimistic	0.01	0.01	0.003

Definitions of Alternative Forecasts: *Baseline:* 3% real growth in R&D each year from 1981 through 1990; *Optimistic:* Real R&D spending grows at 10% from 1981–1987, and then at 3.0% through 1995; *Pessimistic:* Real R&D spending is constant from 1981 through 1995.

*The real potential output contribution equals the growth of the R&D stock multiplied by the estimated output elasticity, .062.

year, close to the record of the past decade but well below the 1955–1965 experience. An even more pessimistic view is generated under the assumption that real R&D spending will continue to stagnate as it has for the past eight years. In this case, current spending will do little more than compensate for the obsolescence of past programs. *Net* investment will be virtually nil, and so will be the contribution to real growth.

In contrast, if a resurgence occurs to push R&D investment back to its peak, mid-1960s' share of GNP by 1983, and then to sustain this share, the potential growth of the economy will be 0.3% per year higher.

These differences are far from trivial. By 1995, a 4.2% output differential exists between the optimistic and pessimistic patterns, which translates into a $663 per capita difference (at 1980 prices). To put this in perspective, the average differential over the next decade would be more than sufficient to pay the interest on the Federal debt. Table 8 shows the cumulative impact of the alternative R&D spending patterns on potential output.

The R&D cure for stagflation will not produce overnight miracles. The macroeconometric model simulations give some indication of the length of time it takes for the alternative R&D spending pattern to impact productivity and, subsequently, prices. There is a two-to-three-year lag before there is any noticeable impact on productivity, and prices do not begin to respond until the fourth year. However, the inflation impacts are greater than the productivity effects because the 1970s' price spiral is encouraged to unwind: better price behavior yields better wage behavior, in turn generating further inflation moderation gains. *R&D investments do reduce, in fact, the total cost of producing output:* the savings in labor and fixed capital costs exceed the research expense because of the high rate

TABLE 8. The Cumulative Potential GNP Impact of Alternative Research and Development Patterns

	1985	1990	1995
I. Percentage Increase Relative to Baseline			
Optimistic	0.6	1.9	2.4
Pessimistic	−0.2	−0.9	−1.8
Differences	0.8	2.8	4.2
II. Absolute Increase Relative to Baseline (Billions of Dollars at 1980 Prices)			
Optimistic	18.0	65.1	91.5
Pessimistic	−6.0	−30.8	−68.6
Differences	24.0	95.9	160.1
III. Per Capita Increase Relative to Baseline (Dollars at 1980 Prices)			
Optimistic	77	267	362
Pessimistic	−26	−126	−271
Differences	103	393	633

of return. The performance margin which is very clear in the industry results would be replicated in the national performance.

The Role of Fixed Capital

Greater investment in fixed capital cannot be expected to have equal anti-inflation leverage on a dollar-for-dollar basis simply because it has been less neglected. The social rate of return is close to 12%[7] far below the 20–35% range estimated for R&D, hence the total cost savings are necessarily lower. However, a strong case can still be made for fixed capital incentives on several grounds. First, a 12% real return is probably more than the appropriate public discount rate: most people would opt for $1.12 next year at the expense of $1 this year (particularly when the $1.12 is indexed to the intervening inflation). Second, it has been well documented by this author and many other economists that capital taxation is, perversely, accidentally severe when prices are increasing rapidly. Finally, the greater the level of fixed-capital investment, the more rapidly new technology from R&D can be embodied in production processes.

The source of weak growth in labor productivity is exceedingly weak fixed and R&D capital spending over the past decade. Only a partial reversal is to be expected without enhanced incentives in the 1980s (Table 9). While fixed capital expansion may have comparatively limited leverage on inflation in contrast to R&D, its magnitude dictates it to be the fundamental determinant of labor productivity and hence per capita living standards.

Specific Policy Prescriptions

The biggest inflation-control bang-for-the-buck can be obtained from strong tax

TABLE 9. Sources of Labor Productivity Growth
(Real GNP Per Worker Adjusted for Transitory Cyclical Movements)

	History					Baseline Forecast	
Contributing Factors	1955–60	1960–65	1965–70	1970–75	1975–80	1980–85	1985–90
Business Fixed Capital Expansion	.95	.88	.84	.05	.58	.57	.47
Additional Capital per Worker	.50	.51	.57	.34	.17	.44	.47
Modernization	.45	.37	.27	−.29	.41	.13	—
R&D Activities	.63	.44	.25	.05	.09	.22	.22
Energy Inputs per Worker	.05	.10	.11	.05	.05	.04	.04
Residual	.76	.74	.59	.60	.53	.70	.70
Total	2.39	2.16	1.79	0.76	1.25	1.53	1.43

Derived from *Technology, Labor and Economic Potential*, p. 88 (see Note 3).

incentives for research and development. If the total return is, in fact, twice the private return to the initial investor, ***a 25% tax credit for R&D wages, supplies and fixed capital spending can be justified as an efficient social investment.*** Assuming the investing firm immediately writes off the expenses of the project, this would approximately double the anticipated ***private*** return, thereby equating it to the full ***national*** return. An example is useful (Table 10).

Reworking the illustration to include alternative tax rates, or to allow only depreciation rather than expensing of the fixed capital component of an R&D project, would naturally modify the estimated private returns, but the same qualitative conclusion would remain. A tax credit of a substantial magnitude is called for to lead the private entrepreneur to make the optimal decision from a national perspective.

This argument can be amplified by recognizing that society can effectively pool the risks of diverse R&D activities to reduce average risk exposure. The individual firm or investor can only do this to a limited extent; therefore, he will require a notably higher anticipated return on R&D projects than on typical fixed capital projects. (This differential is borne out by the rate of return data cited earlier.) Because the risk is reduced for the nation as a whole, a subsidy is indicated again to provide the proper private incentive.

Beyond this specific suggestion, a more ***general prescription is to change substantially the national monetary-fiscal policy mix.*** Simulations with the DRI model of the US economy indicate that ***fiscal restraint offset by monetary ease*** would produce a final demand mix significantly slanted toward investment. Table 11 compares a base forecast with an alternative in which government spending has been cut by $10 billion (at 1972 prices) and Federal Reserve policy has been eased in an offsetting manner. The forecast horizon in each case is 1980–1990.

The results are entirely in line with expectations: fixed capital formation is the beneficiary of lower government spending and more generous Federal Reserve interest rate policies. In this exercise, the Fed has pursued a middle course, in that the unemployment rate is slightly high, but real GNP is also higher. If the Fed had been presumed to target precisely on the base-case real output path, employment would be even weaker by definition because of the greater labor productivity in this alternative policy scenario. Conversely, a presumed Fed targeting on the base-case unemployment rate would have raised demand pressures to cut the inflation benefit.

The Critical Nature of the Policy Mix

The Reagan team has certainly proposed spending cuts, but these are paired with even greater tax cuts. The Fed should not be predicted to be willing to accommodate this stimulus, and precisely the wrong policy mixture thus could prevail: strong fiscal/tight credit.

The scenario builders on the budget team dispute this claim, asserting that inflation will plummet as a result of supply expansion produced by the tax cuts. This is an heroic claim which they admit contradicts history. They are not con-

TABLE 10. The Impact of a 25% R&D Tax Credit on the Private Rate of Return*

	Cash Flow Pattern				
Cash Flow	Year 1	Year 2	Year 3	Year 4	% Private Rate of Return
Gross Flows	−100	15	15	15	15
− Associated Taxes	−50	7.5	7.5	7.5	
= Net Without Credit	−50	7.5	7.5	7.5	15
+ 25% R&D Tax Credit	25	0	0	0	
= Net With Credit	−25	7.5	7.5	7.5	30

*Assume for simplicity: Gross project cost: $100 in year 1, nothing thereafter; Gross project return: $15 per year, year 2 and beyond; Incremental profit tax rate: 50%.

TABLE 11. Changing the Monetary-Fiscal Policy Mix: The Macroeconomic Impacts of Substituting Monetary Policy Ease for Fiscal Stimulus

	Annual Averages 1980–1990		
	$Billions (1972 Prices)	Percentage Change	Percentage Points
GNP	+14.9	+0.8	
Business Fixed Investment	+11.7	+6.2	
Fixed Capital Stock	+41.7	+2.9	
Personal Consumption	+6.6	+0.6	
Federal Purchases	−10.0	−8.4	
Unemployment Rate			+0.2
Inflation Rate			−0.4
Labor Productivity Growth			+0.2
Corporate Bond Rate			−1.1
Treasury Bill Rate			−1.5

cerned about the historical contradiction since they argue that the new regime will produce a structural shift to purely forward-looking expectations, pricing patterns, and wage claims and spending. If they are wrong, the Federal deficit will be massive.

To quantify the budget significance of this dispute over the underlying economic environment, Table 12 indicates the difference between the current Data Resources (DRI) forecast, assuming compromises between Congress and President Reagan, and a "Reaganesque" scenario. Note that these numbers are the ***budget differences produced by the different projected economies, not the economy differences produced by alternative fiscal strategies.***

The arbitrary, heroic, Reagan-team assumption of stronger real growth reduces the budget deficit by raising taxes and cutting unemployment and welfare pro-

TABLE 12. Two Different Economies Produce Dramatic Budget Differences

	Average Values for 1982–1983		
	DRI Economy	Approximate Reagan Scenario	1983 Budget Effect ($billion)
Real GNP Growth (%)	3.1	5	30
Inflation (%)	10.4	8	4
Unemployment Rate (%)	7.0	6	9
Treasury Bill Rate (%)	13.4	11	18
Difference in Deficit			61

grams. Lower inflation has a limited deficit impact, except on debt financing costs, since it simultaneously reduces tax revenues and the cost of government programs.

Both the DRI forecast and the scenario involve tighter credit than would be desirable for accelerated capital spending: the Treasury bill rates are both 3% after adjustment for inflation. This must be the case since both projections involve nominal income growth of 13–14% (the sum of real GNP growth and the inflation rate). The Federal Reserve target of approximately 6% nominal money growth cannot be achieved in such an environment without high and probably rising interest rates, because the normal difference between income growth and money demand growth is close to 4%. Thus, the Fed is willing to support 10% nominal income growth, not 13%. The clash between the demand and supply of funds will keep real interest costs high unless the economy is cooled down by tight fiscal policy further than either of these projections indicates.

Tax dollars are too scarce to sacrifice today on major personal tax cuts. Table 13 gives a clear measure of the greater "bang-for-the-buck" obtained by business, rather than personal, tax cuts. The logic of this advantage is straightforward: business tax cuts have a stronger capacity-creation impact and, due to the high rate of return to private investment, reduce total costs.

Therefore, the mix of policy is critical if the medium-term needs for strong capital spending today in the face of recession are not to be sacrificed in the effort to cut inflation through the use of conservative monetary policy. There is room for a range of expanded traditional investment incentives — fixed investment, tax credits, accelerated depreciation, corporate rate cuts — plus a strong R&D tax initiative.

These proposals to stimulate investment are the most effective route to expanding productivity and living standards. They would achieve the long-term goal of controlling inflation without subjecting the economy to recurrent recessions. Stringent monetary policy alone, the pure monetarist alternative, might make a small dent in the current inflation, but it would extract a heavy toll in foregone investment as businesses cut back in response to vanishing final demand and high

TABLE 13. Relative Efficiency of Tax Cuts[a]

	Effect on Potential GNP[b]	Effect on Core Inflation[c]
Personal Tax Cut	0.16	−0.003
Cut in Corporate Tax Rate	0.38	−0.020
Increase in Investment Tax Credit	1.60	−0.061
Depreciation Reform	1.16	−0.71

[a] Assumes government purchase offset.

[b] Defined as increase in level of potential GNP or decrease in core inflation rate both per dollar loss of total revenue, for the year 1985.

[c] Change in core inflation rate per billion of tax cut for the year 1985.

financing costs. An equally misguided approach would be to attempt a ***sudden*** balancing of the Federal budget. Final demand would be so depressed that capital spending again would decline sharply, rather than rising to absorb the presumed increment to national saving. The best mixture combines selected investment tax incentives, tight Federal spending constraints and more liberal monetary policy.

Notes

1. In Figures 1 through 4 and the accompanying supplementary tables, the growth rates for the subintervals may not appear to be consistent with the full interval in selected cases. In fact, they are fully consistent. The subinterval for 1950–59 presents the rate of increase from the 1950 level to the 1959 level and the subinterval for 1960–69 from the 1960 level to the 1969 level. Thus, the 1959–60 and 1969–70 individual years are not captured in the subintervals, but are included in the 1950–1978 interval.
2. This average is high, relative to the bulk of industries surveyed in Table 1, because the transportation vehicle and equipment industry (SIC Code 37) is included in all manufacturing, but not shown in Table 1 since it includes both motor vehicles and airplane/aerospace industries.
3. Useful references are: (1) Terleckyj, Nestor E., *Effects of R&D on the Productivity Growth of Industries: An Exploratory Study* (Washington, DC: National Planning Association, 1974); (2) Griliches, Zvi, "Research Expenditures and Growth Accounting," Howard Institute of Economic Research Discussion Paper no. 196, 1971; (3) Freeman, Richard B., "Effects of R&D : Social and Private Rates of Return, Investment Opportunities" in J. Herbert Hollomon, Principal Investigator, *Supporting Studies for Alternative Federal Policies Affecting the Use of Technology*, Planning and Policy Analysis Office, Massachusetts Institute of Technology (unpublished); (4) Brinner, Roger E., *Technology, Labor and Economic Potential*, Data Resources, Inc., Special Studies Series, no. 29, 1978. This current essay draws heavily from *Technology, Labor and Economic Potential* and a derivative study, "The Anti-Inflation Leverage of Investment" in C. C. Walton, ed., "Inflation and National Survival," *Proceedings of the Academy of Political Science*, Vol. 33, no. 3 (New York: Academy of Political Science, 1979).
4. Brinner, *Technology, op. cit.*, pp. 97–98.
5. The results are technically drawn from an earlier study of the 1977–1990 time span and would be virtually identical if the 1982–1995 time span were to be evaluated anew.
6. *1985 R&D Funding Projections*, National Science Foundation, NSF 75-314, p. vi.
7. The fixed capital return is drawn from M. Feldstein and L. Summers, "The Rate of Profit: Falling or Cyclical?" (unpublished Discussion Paper).

Mr. **Walgren**. Thank you, Dr. Brinner.

Let me recognize Mr. MacKay and Mr. Brown.

Mr. **MacKay**. Mr. Brinner, on several occasions in your testimony, which I thought was excellent, you mentioned the weak feedback link to the public school systems or to the school systems. Are you saying that we are not adapting rapidly enough in the schools to job needs?

Dr. **Brinner**. Yes; and I would not limit that to the often-cited need for math teachers to teach children how to use an Apple computer. I find that in my own business I need individuals who are more articulate, not just in mathematics, but English, and writing, and speaking. I have a feeling that our school system, either through the financial pressures on it or simply a lack of sufficient dialog, does not understand fully the demands that are made.

I graduated from a liberal arts college. Every time I go back there I try to impress upon the students that that is a very good training.

I believe there is not enough feedback of all different types.

Mr. **MacKay**. Do you see the testimony that you have given as being particularly in conflict with the points expressed by Mr. Chatak?

Dr. **Brinner**. During the break, I was speaking with members of Mr. Chatak's staff, trying to understand some of the issues about retraining, and so forth. I believe we have a similar perspective in feeling that, to the extent to which retraining can be undertaken at the firm with the existing employees, it is very desirable. There is the high cost of turnover to a firm. The firm, if it opens its eyes, recognizes that. Many firms are discovering that by getting greater participation they can ease the sense of tension and anxiety and, in fact, draw on their current employees to do new tasks that they might have assumed otherwise could not be done by those people.

I do suspect, though, that I am more optimistic about the ease that workers can move from one industry to new emerging industries than the presentation preceding me.

Mr. **MacKay**. We have had testimony in the previous panels from persons who said, if you want to really make this country competitive, you have to take some steps so that our employee force will not feel threatened as they do now—properly so, I think—from the idea that in mid-career they may suddenly lose their job. In other words, the suggestion was made that policies could be adopted that were a variation of what was going on in other competing countries; that it would make our work force see technology as a blessing instead of something to be fought against.

I would like your comments on that.

Dr. **Brinner**. As I see new products being developed, even within my own firm, which is based on a mainframe time-sharing activity—and we now see all the minicomputers and microcomputers come in—I see that kind of anxiety even among my staff. The way we address that is through an extensive-training program and intensive involvement of the existing people in the development of the new products to be sold on the micros and minis. That is certainly an easier thing for us to do for someone where they feel that, through foreign competition in a basic industrial activity, they are going to be lost.

This is, again, not an issue of technology as a threat. It is not domestic technology as a threat in this case. It is the foreign technology that is a threat.

Doesn't our trade-related, employment-relocation assistance package cover that kind of issue rather well?

Mr. MACKAY. I do not know. I worry that I hear all of us saying it is not technology that is a threat; it is other people's technology. It strikes me that this is the first time in some 40 years, since World War II, that we have gotten a taste of the kind of disruptive impact other people's technology can have.

Maybe what we are saying now is the solution is to get it so that it is all flowing the other way again. However, if you assume that competition is really going to work that way, then it is going to end up being as disruptive on us as it is on other economies.

Dr. BRINNER. I would not say it was disruptive. If you looked at the Germans and——

Mr. MACKAY. Yes, but you have a job.

Dr. BRINNER. What I am saying is if you looked at the Germans and Japanese after World War II, they had tremendous increases in living standards that brought them well beyond where they were before the war. It was not just a matter of dropping down after the war and then catching back up. They were able to import our technology, adapt it, change it, and use it. That was not a threat to them, either. That allowed their living standard to go up.

The same process is going on as the newly industrializing nations take our technology. I do not think that you should call technology fundamentally a threat overseas, either. It is a process that allows the global pie to be expanded.

Your point, I know, is the one of: As this process of changes goes on in the United States—as the U.S. pie is being expanded—how do we allay the fears of people who think that their slice is dropping out while other people's are expanding, even the national one?

I would suspect that not only having the employer, as we were mentioning, participate in this, but perhaps having some differential tax treatment to allow the individual to use some free-tax dollars on his own to target his retraining. Right now, the individual typically has to use post-tax dollars to pay for his own retraining. That would be a simple amendment, although I would imagine rather expensive.

Mr. MACKAY. Thank you, Dr. Brinner.

If I might, Mr. Chairman, I would like to ask perhaps the gentlemen who reflect Mr. Chatak's point of view if they would care to comment.

Do you see yourselves as being in conflict with the views expressed by Dr. Brinner?

It is a very unusual panel. That is the point I am trying to make. It seemed to me you started in this direction. We then all went off to vote, and I came back and we started in this direction. [Laughter.]

I would like to at least get that point on the table before I leave, so that we can test the points at which you all differ with each other.

Mr. PROSTEN. Your not being present allowed us to resolve most of our differences. [Laughter.]

Mr. **MacKay**. Well, then, we need to get in on that.

Mr. **Prosten**. I think there are perhaps a few basic differences. That is the concern that we have about what happens—assuming that there are massive infusions of technology, that we are on the brink of some introduction that will rival other notable periods in the industrial revolution—we are curious about the fallout that will come from that, particularly in terms of those people who are now members of our organization and in terms of the work that they do.

Will they be affected in some unique way? Will their standards of living, along with those of other similar people who are not members of unions but occupying the same positions in society—will their standards of living be reduced? Will they perhaps be forced into some, more or less, permanent pool of unemployment? Are their skills something that can be salvaged? Are their skills something that can be brought along?

In that area, I suspect that we may see the same problem, but we view it as a deeper one. We are concerned about those for whom high technology does not promise a bright future at this time. How do we as a society take care of them, which was implied in your question—that we don't want to drop those people off the end of the Earth, but how do we do this smoothly?

Mr. **Walgren**. If I might ask, how do you see your organizations in terms of the limitation of concern for those who are not members of your organization? The only rule-of-thumb measurement I have for automation as a model is the mine workers where, as I understand it, essentially John L. Lewis said to the companies in 1938 or 1935, or whenever it was, "I don't care what machines you bring in. Just make sure the workers that are left participate fully in the economic pie that is available to the company."

Looking back at Appalachia, you get the impression that although there were some individuals who benefited who were members of the organization, there was a tremendous amount of the society that was just left without substantial income. Therefore, we found ourselves in 1960 with a whole area of the country that had so declined that their population was not up to any of our values for a standard of life in our country.

Mr. **Prosten**. I am not sure how the introduction of technology in the mine could be faulted. I would expect perhaps you could say the opposite. To stop all technology, which is not something which unions have taken a position in favor of—Secretary-Treasurer Chatak, before he left, suggested that we are not standing at the door and barring technology. The question is, how do we make it fit in better? How do we fit in better with it?

Mr. **Walgren**. I appreciate that, but it seems at this point that the labor representatives are the only ones that are speaking for the groups that may be left out by this. Yet, when I realize, as anyone must, that your first concern must be for the members of your organization—you have a substantial attrition within your organizations simply by the work force getting older—if that is the effective concern of labor organizations, you can probably digest almost any change in technology comfortably if you reserve the benefits for your members.

However, the problem comes, what about those that lie beyond your membership? This is not a question, but I guess I ought to ask: How effective do you think labor organizations are as spokesmen for groups beyond their organization, beyond membership in their organization?

Mr. PROSTEN. That is a very interesting question. How effective? Very effective. More important than that, we are many times the only spokesmen for some of those folks. I do not think labor has ever suggested that it speaks only for itself. There is a wide variety of organizations that, on many social questions, we work in tandem with. One bit of evidence would have been the September 19 Solidarity Day in Washington where there was a variety of groups. It was not just labor, although it was organized by labor.

There is a constituency of groups that shares common concerns in social areas—certainly, employment policy being one of them.

We would like, of course, always to have a larger membership. You would not expect me to say otherwise, nor would you believe it.

However, in terms of how effective are we in their behalf—probably not effective enough. As you suggest, our first commitment must be to those people whose money we take in and in good faith perform tasks on their behalf. However, going beyond that, I think that without labor these other groups are unlikely to be spoken for.

Our testimony and other labor testimony that has been before you suggests that we are equally concerned for those whose role in production at this time is similar to our members. We are equally concerned for them. They are going to face the same sorts of problems.

We are looking for solutions that go beyond just our members.

Mr. WALGREN. I appreciate that. I guess I only raise the point because I think there are built-in limitations on what really interests us. We must be interested in our own circumstances first, and others, at least politically, generally second. I suppose at some point that might limit the concern of organized labor for members of the labor pool that might not be in organized labor.

Enough said on that.

Mr. Brown.

Mr. BROWN. Dr. Brinner, you and the representatives of IUD do seem to start out with a slightly different perspective on this. In the extreme, you are optimistic and they are pessimistic, although there are qualifications on that.

What is your perspective on the problem represented by that very large unemployment figure that was cited in Mr. Chatak's statement, which approaches 20 million people either unemployed, underemployed, or not looking for work, some of which are what you might call structurally unemployed; that is, they do not have a match of skills that matches available jobs? Does technology have a solution to this?

Dr. BRINNER. The first question was: What is our view about the cause of this large unemployment that we are suffering today? I tried to address that in my remarks when I was talking about the extent to which we had, first, an abrupt surge of demand to the economy in the Vietnam era, and then we had two sets of abrupt external shocks from OPEC. Our system has not coped well with either of those. I used the word "need"—the "need" of a recession to cool off inflation, not "need" in the sense at all that it is desirable. It is, in fact, unfortunate, but that seems to be the way our labor and product markets work. Only in the presence of high unemployment and low capacity utilization do we seem to be able to reverse the inflationary process.

It is not so much the case when you have, say, the German approach with some greater collaboration between labor and management. It is not so much the case in Japan where there is a greater degree of national discussion about what is an appropriate way—what the annual bonuses are going to be.

That really is the cause of our current unemployment. We are trying to adjust—and we are not doing very well—to this heritage of inflation from the internal demand surge and the external price shock.

If you ask, what role does technology play in this—and I guess that was the followup question—without being flippant, I think that Clopper Almon hit the nail on the head when he said that you can hardly say in a decade when we had almost no productivity growth that there is a positive correlation between technological advances and unemployment. In fact, the reverse seems to be the case. I tried to give some arguments there.

That is really the macrobasis of my argument. I sense, and am sympathetic to, the anxiety of where are these jobs going to be created and how are the people going to be retrained; but then I look at the historical record, and I find that when productivity growth was strong, unemployment was not a problem. When new products and processes were being developed and America was a leader in a broad range of products, import competition was not a problem.

Although I cannot cite for you just exactly what the retraining programs are that exist in industry today, the macroconclusion is certainly that low productivity growth and an absence of technological adaptation creates unemployment on a structural basis, and not the reverse.

Mr. **Brown**. I think I could agree with you that the root problem is the flat rate of productivity growth. However, looking at the oil shock to which you referred as a cause, I am contemplating the situation in Japan, which had an even greater oil shock because they are more reliant on imported oil, and yet they did not seem to suffer the unemployment recession effects to the extent that we did from that. I assume that reflects the fact that they were able to maintain a higher rate of productivity growth.

Dr. **Brinner**. In Japan their GNP today is further off the track than would have existed in the absence of the oil shock than the United States. Their real wages are lower by a greater proportion than ours are, relative to the track they could have followed. Their unemployment statistics do not show all of that. Their unemployment tends to move up by tenths of a percentage point rather than full percentage points.

While I am not an expert on the Japanese economy, one of my managers, in fact, runs our Japanese forecasting, and he has described the process as a combination of greater wage adjustment. I said we could not adapt and except a lower return per hour and a lower return per dollar invested. They adapted much more rapidly.

We did not, and so we have to go through explicit unemployment and lower capacity utilization. They did a better job, really, of sharing the burden across the work force. However, their real GNP has actually fallen further behind the track than ours.

Mr. **Brown**. Getting to another point, which I think both of you may have emphasized or referred to—that is the need for better linkages. I am looking for constructive things—that we can agree to which would ameliorate the situation. Focusing on the problems of education, it does seem to me that we can agree that the general adaptability of the society and the economy would be improved if we could create these improved linkages between the private enterprise job-creating sector and the schools as a job-training sector. I am not quite sure how that ought to be done. I am looking for ways.

I assume that we start out by developing institutional mechanisms in which these two parties or other concerned parties—maybe including Government—should be seeking to exchange data and to help each other in terms of providing information about opportunities and in terms—on the part of the school—of adapting to changes that may be required, including the change of educating people who can be retrained more readily, whether in specific skills or whatever.

Can we agree that this is a desirable route to take under any circumstances?

Dr. **Brinner**. We can certainly agree that it is desirable. I suppose that I am honestly at a loss for explicit things—explicit instances where the Federal Government could effectively intervene, either directly or through tax activities, other than the ones that I mentioned to aid that process.

It is encouraging to me that the process does seem to be equilibrating. There is a broad awareness now of the problem. Your committee is addressing it in a series of numerous panels. I, too, have found the materials that I read very interesting and good.

I read in the paper continually about that. The Wall Street Journal had a series on displaced workers who were being retrained.

There is a growing awareness, and perhaps just the process of stimulating that awareness through hearings such as this is as valuable as explicit expenditures or tax breaks.

Mr. **Brown**. I would like to see it go a little further than that, although not necessarily involving Federal intervention. However, it seems to me that there is a role for a little more enlightened corporate leadership in terms of their willingness to provide training opportunities or to facilitate retraining of their own employees, and perhaps to work in a closer relationship with their local education and training institutions in order to make sure that the supply of personnel matches the supply of jobs. Is that unreasonable?

Dr. **Brinner**. No. I think the problem the employer sees is that if he, being a small part of an economy, goes to help a public school, very little is going to come back to him individually. That is what leads to the formation of chambers of commerce and interested employee groups. When all of the firms in an area get together and determine that there is a need and respond to that and then support it as a group, the group benefits from the group's activities and they can all share.

However, there is the problem of the spillover benefits if just one firm does it. That usually leads to the decision to give tax credits to support it and give some of those spillover benefits back to the firm. I take it that was a large, implicit part of the decision to put R&D credits on, and I applauded that in the testimony and suggested perhaps it could be extended to corporate involvement with schools.

Mr. Brown. Of course, it should be encouraged. I am not sure what the mechanism for encouraging it is.

Picking on the IUD for a minute, it seems to me that the statistics that Mr. Chatak presented with regard to the job-creating potential of new technology distorts the picture a little bit in the sense that it correctly projects the increase in the number of jobs in certain specific data processing and other fields. It omits, however, the jobs created as a result of the development of whole new industries.

Just to give you one example: There has been an explosion in computer games. I am not particularly enamored with computer games, but these are really nothing but another kind of electronic-assembly job. Nevertheless, there have been thousands of them created to replace some of the jobs perhaps lost in steel or autos or some of those things.

Did the IUD attempt to project this development of entire new industries, even though they might not employ, say, computer programers or other specialized occupations of that sort?

Mr. Beckman. In our testimony—and I do not know if it was in the version that was cited here, but in the longer one that you have—something like 15 percent of the jobs in so-called high tech industries require advanced skills. The rest of the 85 percent requires similar skills to what steelworkers or autoworkers or workers in the electrical industry perform.

However, it is quite clear that in the current flux of our industrial economy those jobs in industries such as computer games—specifically in computer games—are not reliable sources of employment. The recent move of something like 1,700 jobs by Atari to a foreign-based plant is an indication of what we can expect in those new industries. They do not seem to be the kind that are going to be around for 50 years and provide stable employment for families and for regions in the way that the auto industry and the steel industry have done in the past.

Therefore, when we are thinking about what the impact is of this new technology, that is an important consideration—that these jobs can move very quickly. There is not a tremendous investment in a big building and a large amount of equipment that cannot be moved in the way that we normally think of industrial growth.

Another thing I would like to comment on is that in discussions of the adjustment process there has been the implicit assumption that there is eventually going to be enough employment; if we just let the market system go through its paces, that will result in a similar situation of similar levels of employment, but they will even be better paid than they are now. It takes a tremendous amount of faith that we in the labor movement have lost quite a while ago. We do not believe that that adjustment process takes place automatically or systematically.

I think if we are going to cite the series of articles in the Wall Street Journal on retraining, it seems to me that the people whom they focused on—who, in fact, had gone and obtained some training—were really floundering. They had absolutely no idea what kind of jobs were going to be available. They were looking for some kind of reed to hold onto—to find something that they thought might be a useful skill to have in the future.

It seems to me that to provide some kind of useful retraining program we have to have a much better idea of what kind of jobs will be available in the future. In order to do that, I think a much deeper analysis of where employment is going to be located or what industries are going to grow has to be done. I think we may be starting along in that process, but there are a lot of people who are not interested in letting unions know where they are going to be locating their investment. There are a lot of people who are not interested in having the Government know where they are going to be locating their new investment.

Until we have some kind of process that includes that, we are not going to be able to have an adequate retraining program.

Mr. **Brown**. I sense a nostalgic cry for better economic planning and industrial policy. I do not see that developing in the near future in this system—much as we might desire it.

I want to cover just one other point, if I may, Mr. Chairman.

Getting back to the productivity focus for a moment, I see systematic efforts to improve productivity as being something that both labor and management ought to be able to engage in on a cooperative basis with substantial benefits to all parties. Obviously, productivity improvement tends to expand markets and job opportunities. By the same token, the participation of the employees in the process of productivity improvement—it seems to me—offers opportunity for inculcating skills of a wide variety; that is, if they actually become partners in the process—as I think they should be accepted as partners by management—it improves their own motivation. It improves their analytical skills. It improves possibly even their learning skills, which are transferable assets in case jobs do radically change.

From that standpoint, we ought to be doing something to foster this joint and cooperative effort of productivity increase, which means the unions ought to be involved in that.

Is that too heretical, or can you speak to that?

Mr. **Beckman**. No, I do not think it is at all out of line with what is going on. In fact, in several industries I think, if anything, the labor movement would be pleased to be engaged in this kind of cooperative project in more places. Where it is done cooperatively, the workers can be adequately informed of what the impact is going to be on them. They are not taken by surprise when, all of a sudden, either the plant closes or their product lines moves. There are studies that show that unions are not an impediment to technological change and productivity improvement. The major impediment has come from management. The management people responsible for getting the product out are very fearful that a new piece of equipment or a new technology is going to screw up their planning and is going to inhibit them from attaining their projected goals, and there goes their bonus.

I think the workers, when they are involved in the process, have been very cooperative. I do not think we could be more interested in establishing these kinds of discussions with management, wherever they are interested in doing it.

Let me make one more remark about the slow growth in productivity that came up before.

It is a mistake to equate a slow growth in national aggregate productivity with the lack of introduction of new technology. Because during the 1970's there was a very slow rate of productivity growth does not mean that there was not new technology being introduced during that period. In fact, quite a bit was introduced in that period. The reason for the slow productivity growth is not very well understood. It does not seem to have been related to capital investment. New studies have shown that. The investment was going on, but the numbers did not come out the way they ordinarily do.

If you ask any of the representatives of our union, they will tell you that there was plenty of new technology implemented during the 1970's that had a profound effect on the workplace—the types of jobs that people were required to do and that were available.

Mr. **Walgren**. Thank you, Mr. Brown.

There are a number of areas that would be very interesting to explore, but I am afraid time does not permit. I want to thank you very much for your contribution.

The next panel is made up of Daniel Yankelovich, the chairman of Yankelovich, Skelly, and White, Inc., and Eileen Appelbaum, professor of economics at Temple University.

I want to thank the witnesses for their patience. We appreciate your still being here. Our schedule today was somewhat inverted by events that are not within our control. I apologize for that.

Let's start with Mr. Yankelovich, and then, Dr. Appelbaum, we would be pleased to hear you.

[The biographical sketch of Mr. Yankelovich follows:]

DANIEL YANKELOVICH

Daniel Yankelovich, is founder and chairman of Yankelovich, Skelly and White, one of the nation's largest and most-respected opinion research organizations.

Trained in philosophy and psychology at Harvard and the Sorbonne, Mr. Yankelovich, 59 , has been regarded, for over a quarter of a century, as one of America's foremost analysts of social trends and public attitudes. As a researcher, lecturer, consultant and author, he has contributed his insights to such diverse fields as foreign affairs, the changing nature of the labor market, youth attitudes and domestic political affairs. His most recent book, NEW RULES: Searching For Self-Fulfillment In a World Turned Upside Down, was published by Random House in 1981.

In the area of public service, Mr. Yankelovich is associated with many organizations, including the Council on Foreign Relations, Aspen Institute, the Kettering Foundation and Brown University. In 1975, Mr. Yankelovich was a co-founder of The Public Agenda Foundation, a non-profit, non-partisan organization which he now serves as president.

STATEMENT OF DANIEL YANKELOVICH, CHAIRMAN, YANKELOVICH, SKELLY, AND WHITE, INC.

Mr. YANKELOVICH. Thank you very much, Mr. Chairman.

Listening to the testimony this afternoon, the testimony particularly of Representative Zschau and Mr. Chatak, and then the dialog between the committee and the last panel, shows how much anxiety and political tension is associated with this issue.

Representative Zschau was concerned that we will not go far enough with technology to improve our competitiveness and thereby create jobs in that way. Mr. Chatak was concerned that we will go too far, in a sense, and lose jobs. Both of the concerns are legitimate and very serious concerns, and yet each of the two emphasize such different solutions that they seem almost incompatible. Some of the dialog this afternoon was an effort to find ways of reconciling and find some solution that transcends those differences and takes both of those concerns into account. My comments this afternoon are in that spirit, recognizing the legitimacy of both concerns and finding some way to take them into account and to bridge them.

I would like to mention very briefly one positive trend that I see leading toward the future—this panel focused on the future—and one negative one, and then comment on what, from my perspective, I see as some of the far-reaching implications for Government action.

The positive trend—and I am looking at this from the perspective of studies of people in the work force, basically survey data conducted over a period of time, and you see a somewhat different picture than you get from labor statistics or some of the economic data—on the positive side there is a very strong and clear sense from survey data that jobs are getting better; that the jobs are, in effect, growing less tedious, back breaking, monotonous, routine, and demeaning. They are becoming, on the whole, more interesting with greater freedom and greater discretion by the individual over the effort of his or her work, over the quality of that work.

A number of factors are responsible for that long-term shift, particularly the shift toward white collar and away from certain categories of blue collar jobs. One of the factors seems to be an upgrading of jobs through technology.

One of the questions that we asked in a study conducted by the nonprofit Public Agenda Foundation, that I am associated with—it is a study that is not yet published; it will be released by Labor Day, but it is available to the committee—we got some sense from the work force about the number of people whose jobs in their own experience were affected by technology, and it was almost half—some 45 percent—who had experienced a substantial effect of technology in their jobs over the past 5 years or so, by their own interpretation.

Then, we asked whether the result of that was to make the jobs more interesting or more monotonous—that type of question—gave them more freedom or less freedom. The results were really quite clear-cut. Some 76 percent reported that the effect of technology on their jobs had been to make the jobs less monotonous, more interesting. Twenty-two percent felt that the jobs had taken away some degree of freedom and had made the jobs more tedious. You cannot dismiss that. That is one out of five, but at the same time the overall thrust is really quite clear-cut and very sharp.

There has been, in addition, a wave of entrepreneurism in the country, which I think we will see accelerating in future years, with the kind of excitement that comes to people from starting their own businesses, from being associated with small business—the kind of interest and stimulation that simply is not associated with working in large, bureaucractic organizations.

The implications of jobs getting better in this sense—a qualitative sense—are quite far reaching. I will mention just three implications.

One is that more people want jobs. We have seen that with respect to women. My prediction is that we will see a reversal of the trend toward early retirement in the future if jobs are available.

The union representative and some of the union testimony—previous union testimony—has emphasized the fact that maybe we should go even further toward early retirement. However, if you consider both the cost of doing that to society and the fact that the people do not want it—that the thrust is the other way where the majority, a two-thirds majority, would not want early retirement, if they had their druthers, but would rather go on to the normal age of retirement or beyond in work—that is perhaps somewhat adjusted. It is understandable, once one looks at the nature of jobs.

Second, the meaning of work has changed, with greater emphasis in the workplace on self-development, on the challenge, on the inherent interest of the job, as well as its financial reward. With it—from the survey data—a very striking improvement has occurred in the work ethic, in the feeling that good work is meaningful in its own right. That is not surprising. If the work is good, if it is interesting, if it is well paid, if people like their work, they are likely to feel a stronger sense of the work ethic, which from the point of view of our potential competitiveness is a very important potential asset that we are not taking full advantage of, but perhaps will in the future.

Another implication is that if jobs are so desirable and meet so many needs, mere income maintenance, especially at low levels, is not in a sense a substitute for jobs. In a Swedish industrialist's words, "A person without a job in modern society is a powerless outcast, even though some of his elementary economic needs may be cared for." I think we have to have that sense and look at this problem from the point of view of that changed meaning of work.

If you see that trend interacting with a negative trend, which is that in the short run—in the next 5 to 10 years—there may be a considerable shortfall between the number of people who want these good jobs and the number of good jobs available, I think that the figure of 19 million people who, in a sense, want jobs—the market is understated. Eli Ginsburg feels it is understated. Our figures, our calculations, are upward of that. They are likely to go even further.

My opinion is that the widespread assumption that economic recovery is going to take care of the unemployment problem is a false assumption, a specious assumption. It seems faulty. The reasons are fairly clear-cut. We have touched on some of them this afternoon, but I would underscore one that I think is particularly important, which is the lack of competitiveness. That lack of competitiveness does not seem to be diminishing. In fact, there seems to be a very striking weakness in our management on the people side.

One of the achievements of the Japanese has been to combine high technology with high motivation—committed people who look at technology as a blessing rather than as a threat. That is a powerful combination—a powerful factor in productivity.

When you look at our work force and their attitudes—let me just cite three statistics, survey statistics, that underscore the problem that we see.

One is that a whopping 73 percent of jobholders sees virtually no relationship between their performance and their reward. That is to say, they do not feel that if they are more efficient it is going to be reflected in their reward, as against 39 percent in Japan, on the basis of a comparable study. Quite a difference.

Only 13 percent of the work force feels that if they do improve their performance they would be the major beneficiary of improved performance. There, again, they do not see that they have a real incentive to give more.

Only 22 percent of the work force feels that they are working at their full potential.

I find these astonishing numbers—this is a very up-to-date study—if we are looking at improving our competitiveness, particularly on the people front.

On this matter that technology will create more jobs than it destroys, which we have been discussing at some length this afternoon—this is an article of faith. Most business executives hold it as an article of faith. Many people—we heard the union representative say he does not believe in it. However, neither the belief nor the disbelief is based on fact. We do not know. We do not know what the evidence is, and we certainly do not know how long the transition will take.

It seems to me that, even if that turns out to be the case ultimately, the transition is going to be a long one and a very painful one, and that is what gives rise to this nervousness that we hear reflected in some of the testimony.

With respect to the role of Government, the situation is not yet clear enough to perhaps pinpoint or describe very specific pieces of legislation; but I think that there are two major roles for Government in the future which I would like to emphasize as possibilities.

One has to do with cushioning the transition, with providing the individual with more flexibility, with adaptability for the individual. In a sense, if we are going to retain the flexibility of the overall system that David Birch in his testimony argued for, and others have argued for this afternoon, we cannot let individuals take all the risk. If they do, they will strike back. We will have the worst of both worlds.

From almost every point of view—it seems to me—some major focus on cushioning in the transition has to be provided in some six areas: relocating, income maintenance during the transition, counseling with respect to job change—the individual does not know what jobs are available—training and retraining in the sense of enhancing people's employability, providing information, and providing people with job-seeking, job-finding skills. I think that when the dust clears 5 years from now, or a few years from now, we are going to have very far-reaching legislation and programs in those areas—unprecedented in their scope, because I believe we are entering a period where the threat to people who are not used to being threatened is unprecedented. To blink at it seems to me to be very shortsighted.

Second, it seems to me that the Government will inevitably have to get into the job-creation business in a much more active role and with much greater zeal and concern than in the past. To the extent that job creation is basically a matter of wealth creation, then that means much more attention, however it is done, to maintaining our competitiveness in the traded parts of our economy, so that our industrialists can take a long-term point of view. An industrial policy and planning, as Representative Brown points out, may not be compatible with our system, but if the Japanese can get 2-percent money, that sure helps to stretch your point of view and make you more long term in your thinking. We have to somehow take those factors into account.

I think a great deal more can be done to support entrepreneurship. It is one of our great assets. It is a natural trend. It can be supported and stimulated in countless ways.

The whole matter of resource allocation from consumption to production, I think, becomes a critical point. We are expending—our budget deficits show—where our priorities are. In some sense, it is up to the Congress of the United States to wrestle with that issue, leading to, I believe, a shift in priorities in the use of resources in the direction of production, infrastructure, and the like.

I have run over my time, so I will not try to elaborate those points; but that is a general view of how these positive and negative trends interact and what at least one observer sees as the implications for Government.

Thank you.

[The prepared statement of Mr. Yankelovich follows:]

STATEMENT BY
DANIEL YANKELOVICH

Mr. Chairman, Members of the Committee, in the time that is available to us this afternoon, I want to mention briefly one important positive trend and one negative trend, and then suggest what I see as some of the far-reaching implications for government action.

The Good Trend

On the positive side, research carried out over the past several years by the Public Agenda Foundation, with which I am associated, strongly suggests that jobs are getting better. In the view of workers themselves, jobs are growing less tedious, less backbreaking, less monotonous, less routine, less demeaning. Jobs are becoming more interesting, with greater individual freedom and more individual discretion over both the level and quality of work effort. A number of developments are responsible for this significant long-term trend. But one of the most important seems to be an upgrading of jobs through technology.

In a new survey of workplace issues conducted by the Public Agenda last fall among a national cross-section of jobholders, almost half (45%) of the people interviewed said their jobs had been affected in some way by technology over the past five years. Among this group, nearly eight out of ten (76%) said technology had made their jobs more interesting, two-thirds (65%) said it had made their jobs easier, and a majority (54%) said it had made their jobs more independent. Barely one in five (22%) said technology had made their jobs more monotonous, and only one in seven (14%) said it had changed their jobs for the worse. [These and other findings of the survey are discussed in detail in Putting the Work Ethic to Work, by Daniel Yankelovich and John Immerwahr, available from The Public Agenda Foundation.]

These statistics do not tell us anything about the Americans who lost their jobs because of technology. But for those who held their jobs, the overall positive thrust is quite clear-cut and encouraging.

Another factor in improving the overall quality of jobs has been the wave of entrepreneurism sweeping the country. More new enterprises are being created every year. I think we will see this trend accelerating in the years ahead. There is a kind of excitement Americans feel in starting their own businesses, an interest, stimulation and dedication that is simply not present to the same degree in most large, bureaucratic organizations.

Whatever the reasons, the implications of jobs getting better are profound. One is that more people want jobs. We see this most clearly in the steadily increasing percentage of women participating in the workforce. My projection is that in the future we will also see a reversal of the trend toward earlier retirement, if good jobs continue to be available. Some observers have suggested earlier retirement as a possible solution to the projected shortage of jobs. But, before going down this road, we ought to consider both the cost to the economy and the society, and the fact that most older people simply do not want to stop working. The thrust of people's current preferences is quite the other way. A two-thirds majority of those interviewed in the Public Agenda survey would prefer to continue working until the normal age of retirement, or even beyond that age in types of work adjusted in hours and level of effort required of them.

A second implication of the improved quality of jobs is that the meaning of work has changed. Fewer Americans work simply to survive. More work to improve their standard of living and quality of life. Today, we find a greater emphasis in the workplace on self-development, on the challenge and inherent interest of the job, in addition to the financial rewards. With this changed meaning has come a striking improvement in the work ethic: the urge to do good work for its own sake. This is not surprising. If the work is interesting and well paid, if people like their jobs, they are likely to make a stronger commitment to them. From the point of view of our future competitiveness in the world economy, the strength of the American work ethic today is a potential asset of which we are not taking full advantage.

A third implication is that if jobs are so desirable and meet so many human needs, mere income maintenance -- especially at low levels -- will not be an acceptable substitute for jobs. In the words of a prominent Swedish industrialist, Pehr Gyllenhammar, in modern society a person without a job is a "powerless outcast," even though some of his or her elementary needs are being cared for. In addressing this problem, we have to look at it from the point of view of the changed meaning of work.

The Negative Trend

On the negative side, over the short term -- the next five to ten years -- there may well be a considerable gap between the number of people who want jobs and the number of good jobs that are available. I think the figure of 19 million, which has been used previously in these hearings to pinpoint the magnitude of the gap, may prove to be understated. I also believe that the widespread assumption that economic recovery is going to take care of the unemployment problem is false. I would underscore one reason: our continuing lack of economic competitiveness in many industries, such as automobiles, that employ large numbers of Americans.

We are beginning to focus on some of the reasons that American products are not as competitive in world markets as Japanese products -- unfavorable exachange rates, trade practices, lower levels of investment, etc. But we give insufficient attention to one key factor: there is a striking weakness in our management policies and practices on the people side. One of the achievements of the Japanese has been to combine high technology with high motivation. The typical Japanese worker looks at technology as a blessing rather than as a threat. That is a powerful factor in enhancing productivity. Credit for this fact is often given to the uniqueness of Japanese culture. But I would stress management policies, not culture. When we look at our American workforce and its attitudes, we see the clear results of unsound management policies. Let me just cite three survey statistics that underscore the problem as I see it.

First, a whopping 73% of American jobholders see little relationship between their performance and their rewards; that is to say, they don't feel that if they were more efficient on the job, it would be recognized and rewarded. On the basis of a comparable study, only 39% of Japanese jobholders feel the same way. [See Work and Human Values: An International Report on

Jobs in the 1980s and 1990s, Yankelovich, et al., The Aspen Institute for Humanistic Studies and The Public Agenda Foundation, 1983.]

Secondly, only 13% of American jobholders feel they would be the major beneficiaries of their own improved performance. Again, they don't see any real incentive to give more.

Finally, only 22% of American jobholders state that they are now working at their full potential.

If we are concerned about improving our competitiveness, we have to pay heed to these astonishing findings. Clearly, our business managers have a good deal of work to do to improve their incentive policies.

On the question of whether technology will create more jobs than it destroys, or the reverse, the debate on both sides seems to me largely a matter of blind faith. Neither the optimistic nor the pessimistic projections are based on reliable evidence. The technologies are simply too new, and evolving too rapidly, to say with confidence what their long-term impacts will be. We can be assured, however, that the transition will be lengthy and in some cases very painful.

With respect to government, there are two major roles for government in the future that ought to be considered. The first is cushioning the transition. As technology transforms our economy, it is grossly unfair to let individuals take all of the risks. We should help to provide the individual with the flexibility, skills and resources he or she needs to adapt to a new world. Help to individuals in making the transition has to come in some six areas:

(1) Assistance in relocating jobholders to areas where jobs are more plentiful;

(2) Some plan to help people maintain some income during the transition from "old" to "new" kinds of work;

(3) Counseling with respect to job changes;

(4) Job training and retraining designed to enhance people's employability;

(5) Improved information about the availability of jobs and the skills required to do them;

(6) Providing people with improved job-seeking and job-finding skills.

I believe that when the dust clears a few years from now, we will see far-reaching programs in these areas inspired by government. We are entering a period when the threat to people who are not used to being threatened is unprecedented. To blink at that threat seems to me shortsighted. Failure to prevent workers from being victimized by technology will make them oppose the kinds of technological innovations we need desperately to improve our competitiveness.

Secondly, the government inevitably will have to get into the job-creation business in a much more active way and with greater zeal and concern than it has in the past. It needs to be concerned, in particular, about what it can do to stimulate among our industrialists a longer time perspective. As one industrialist recently commented, "If I had access to money at two percent interest like the Japanese do, it sure would help to make me more long term in my thinking." I believe we need a whole range of policies to encourage the private sector to think more creatively and effectively about job-creation.

A great deal more can also be done by government to support entrepreneurship -- Americans starting their own businesses. It's one of our great assets. It's a natural trend which can be stimulated in countless ways.

We also need to focus on the reallocation of resources from consumption to production. This is a critical need, one that should directly engage the Congress of the United States.

These are very large topics. I would be pleased to elaborate in discussion.

Mr. WALGREN. Thank you very much, Mr. Yankelovich.

Dr. Appelbaum.

[The biographical sketch of Dr. Appelbaum follows:]

Curriculum Vitae

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M.A., Temple University - Mathematics, 1965.
M.A., University of Pennsylvania - Economics, 1970.
Ph.D., University of Pennsylvania - Economics, 1973.

Scholarships and Fellowships:
Temple University Scholarship, 1958-1961.
University of Pennsylvania Fellowship, 1966-1968.

Positions Held:

Instructor in Mathematics, Temple University, 1961-1968.

Instructor in Economics, Temple University, 1969-1972.

Assistant Professor of Economics, Temple University, 1972-1980

Research Associate, Research Center for Economic Planning (Dr. Thomas Vietorisz, Director), 80 Fifth Avenue, New York, N.Y. 10011, 1973-1976.

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Managing Board of Editors, Journal of Post Keynesian Economics, 1977 to present.

Senior Research Associate, Center for Economic and Anthropogenic Research (Dr. Alfred Eichner, Director), Rutgers University, New Brunswick, N.J. 08903, 1980 to present.

Visiting Professor of Economics, University of Massachusetts (Amherst), 1980-1981.

Associate Professor of Economics, Temple University, 1981.

STATEMENT OF DR. EILEEN APPELBAUM, PROFESSOR OF ECONOMICS, TEMPLE UNIVERSITY

Dr. **Appelbaum**. Thank you, Mr. Chairman.

I am very happy to be here and very impressed, as others have been, with the testimony that you have received to date. The testimony that was sent to me was striking, I thought, for the realism that it exhibited with respect to what high tech can do, what it cannot do, and what the nature of the problems are likely to be.

In my written testimony I have left with you two papers that deal rather broadly with these issues. However, because I have only 10 minutes here, I thought that the best thing to do, having looked over some of the testimony you received, was to pick up on two points that I thought were not emphasized sufficiently in the earlier panels.

The first point that I want to make actually has been the subject of discussion with the previous panel, and I hope to have the opportunity to answer some of the questions. I thought they were excellent questions, and I hope you ask them of me, also. I am referring to the persistence of structural unemployment. Perhaps you can say, if you look at the 20 million people who are unemployed, discouraged, or working parttime involuntarily that it is not the fact that technology in some very narrow sense—in the sense of a new innovation that has taken place and has thrown 20 million people out of work—in that narrow sense perhaps you cannot attribute what has been happening to technology.

However, I thought, Mr. Chairman, your remarks with respect to the mining industry and what happened in Appalachia parallel exactly what I wanted to say with respect to agriculture. Some observors seem to believe that there was an agricultural revolution and then the workers displaced by it were picked up in the industrial revolution and became manufacturing workers; and the workers displaced by this are going to be picked up in the information revolution and become service workers; and that the agricultural revolution took place a long time ago, and this is the way it is going and there are no problems. I find this reasoning objectionable.

In reality, the agricultural revolution was completed in 1950. Most of the major innovations that were labor displacing took place in this century in sugar and in cotton. When I look at the problems of the innercity, when I look at unemployment in the innercity—as far as I am concerned, that is technological unemployment left over from the advances in agricultural technology.

When you talk about workers who are displaced and you are talking about structural unemployment, that is exactly the issue we face again. It is not necessary to exaggerate the problem. I am not a doom-and-gloom prophet. I am not trying to bring to you a message that says no one will ever work again; we are going to have peopleless offices and peopleless factories. That is not the way I view it.

However, in the 1950's we had rapid rises in productivity growth. We had tremendous increases in employment. However, you notice that a substantial proportion of those workers displaced from production in sugar and cotton were not absorbed even by our growing labor force and our growing economy and the new jobs that came along. Their children, in many cases, have not been reabsorbed.

When I look at the blue-collar workers in the Midwest and the Northeast, this is the nature of the problem as I understand it. It is not that no one is ever going to work again; but it is true, in my opinion, that there will be serious problems of workers—groups of workers—left behind in the process of economic growth and in the process of technological change. That was one point I wanted to make.

In my opinion, it is a persistent problem. It does not disappear by itself. You cannot rely on market forces. The agricultural revolution which was just completed is an example, or the one that you pointed out in mining is an example, of what we might expect to happen if we leave the economy to its own devices.

Now with respect to what is happening currently, what is happening to structural unemployment? It is very difficult to get good numbers. I know that you have been looking at numbers, and you know how hard it is to find them.

The number that I look at is the unemployment rate at the cyclical peak. I would argue that at the peak of the business cycle you have the least amount of cyclical unemployment, and the unemployment you register at that point—to a greater extent than other unemployment figures—reflects mismatches between skills, the inability of the economy to absorb workers, and so on.

When I look at those particular numbers, I see that unemployment at the cyclical peak prior to the 1969–70 recession was 3.4 percent, prior to 1973–75 was 4.8 percent, prior to the 1980 recession was 6 percent, and prior to the 1981–82 recession was 7.4 percent. It has doubled in a decade and a half. That is the nature of the problem.

In earlier testimony you did have someone say that they anticipate that, due to advances in technology, even if there is high productivity growth in the next decade, there will be a 1.3 percent increase in unemployment. That is the number I have been bandying around myself. Without an econometric model—just looking at what is happening—I think that is about right—another million or million and a half workers to be displaced.

The problem is that it is a million or a million and a half on top of 7.5 percent of the work force that were experiencing structural unemployment as we went into this recession. Therefore, the number—the total number—experiencing structural unemployment is not on the order of 1.5 million. That is just the latest turn of the screw. It is on the order of 8 million. Again, we are not talking about 30 percent of the labor force or 50 percent of the labor force. We are talking about 8 percent or 8.5 percent of the labor force. I consider that a serious adjustment problem.

If we look at our trading partners, the other developed countries—I am speaking now of Western Europe and Japan—we see that the United States was probably better off than these countries in terms of opportunities. Our total employment growth was much higher in the United States than in either Western Europe or in Japan. Those countries are all experiencing—including the Japanese—a decline, an absolute decline, in the number of manufacturing workers. Whereas, between 1969 and 1979, this country experienced an increase on the order of 700,000 manufacturing workers. Therefore, the industrial restructuring in Japan and Western Europe has been more severe than the industrial restructuring in the United States.

Yet, our unemployment rate is two to three times as high as the unemployment rate—and I am speaking of the cyclical peak; I am not speaking of the current business cycle—in Japan or Western Europe, with the exception of the United Kingdom. With the exception of the United Kingdom, we have done much worse than the other countries in facilitating the restructuring of our industrial base.

If I look at what the reason could be, it will not be any surprise to this audience. The big difference is, I think, that, unlike Western Europe and Japan, we lack both vocational training programs and help with relocation and reemployment through the public employment service for displaced primary sector workers. I do not want to elaborate. Mr. Yankelovich has already said it, and I know you have heard it before. However, I think that is an important issue.

Mr. DYMALLY. Would you repeat that, please?

Dr. APPELBAUM. If you look at the issue of why we have been less able to reabsorb workers than other countries have: They have much more extensive programs of vocational training and retraining; they have relocation services; they have the counseling services; and they do them through the public employment service, and I will have more to say about the public employment service.

Mr. DYMALLY. Just a comment. I do not think that any expert who would make public the statistics you have referred to would be invited to serve on the White House Council of Economic Advisers. [Laughter.]

Dr. APPELBAUM. I want to say one other thing. I have talked about the primary sector workers. We can also talk about disadvantaged urban workers. The CETA programs you might think have been directed to disadvantaged urban workers—and they have—although they were not initially intended for that purpose. By the late 1970's, 95 percent of the people in the CETA program were disadvantaged urban workers.

At the same time that we made that shift, it may interest you to know that we cut down on the amount of job training associated with CETA. We moved toward public service employment and away from job training, so that by 1980 only 16 percent of the CETA funds were dedicated to job training. That includes both institutional job training and on-the-job training. Total expenditure for training through CETA in 1980 amounted to 16 percent of CETA funds.

Whether you are looking at displaced primary sector workers or you are looking at disadvantaged urban workers, in neither case are we providing any kind of job training to speak of.

Now, we do have a new bill, the Job Training Partnership Act, which introduces several changes. It is too soon to evaluate. I want to withhold judgment. I just want to say that it appears as if this program will make it possible, at least, to have job training programs for primary sector workers. I think that is an improvement, although I do not know what is going to happen.

The labor economist, Michael Podgurski, has shown that the Federal Government was spending nearly four times as much for training per unemployed worker in 1970 as it is today. While that act has some potential, the level of funding at the moment for unemployed worker is so low as to make you wonder what can be accomplished.

I want to speak briefly about the public employment service. I feel that one of the big problems in this country is that we are not making the best use of that institution. I think that we have given it the mandate, but not the power to fulfill its function.

Mr. **MacKay**. Mr. Chairman, if I might just interrupt——

Mr. **Walgren**. Mr. MacKay.

Mr. **MacKay**. I would like to be sure I understand what you say. I understand that the employment service has the mandate not only to do the employment work, but also to develop the system nationwide so one can find out where the jobs are——

Dr. **Appelbaum**. That is right.

Mr. **MacKay** [continuing]. And one could, if he got it on the same computer, match overnight the job skills available with the jobs.

Dr. **Appelbaum**. That is correct.

Mr. **MacKay**. I understand that is being done now manually by sending material in to some place——

Dr. **Appelbaum**. You are right.

Mr. **MacKay** [continuing]. And that you get it back 90 days later, if ever.

Dr. **Appelbaum**. That is right. The resources are limited that are being spent on this. It was a good innovation. I have mentioned that here. One important innovation is this computerized job bank, but it has limited resources and lists only small proportions of the job vacancies.

In the European countries, in the OECD, every person who is out of work and looking for work must register with the public employment service, and every employer who has a job vacancy must register it with the public employment service. You can see what a difference that is going to make in terms of matching workers with skills.

Also, job counseling, job relocation, and access to the job training program is through the public employment service. Therefore, the public employment service in European countries has a lot of respect. There is a high regard for it, and it is able to fulfill its mandate.

Mr. **MacKay**. I also understand that the public employment service has people available to the public schools, which is in this country considered heresy.

Dr. **Appelbaum**. That is right.

Mr. **MacKay**. Yet, the counselors in the public schools consider it heresy when it is suggested that they should give vocational guidance. They give guidance to the group which graduates—which is the one group that needs it less than anybody else.

Dr. **Appelbaum**. Let me go on with my testimony. If I have time, I would be happy to speak to that, too.

Mr. **Walgren**. If I can ask just one aside, and we will not hold you to time. We will have lots of flexible time.

Dr. **Appelbaum**. Certainly.

Mr. **Walgren**. At the peak in this employment service business, how many jobs are listed, even though late?

Am I right in intuitively thinking that we have not really done a good job with that because, when you really look at the resources that get listed, they in no way compare to the numbers of people looking for work?

Dr. **Appelbaum**. Right. I do not have numbers for you, but I do know that it is a small proportion of the total jobs.

The second thing is in this country the private employment services have creamed the top. In other words, the good jobs never get listed with the public employment service. Since there is no regulation that says they must, they are not mandated to do so, they simply do not.

The public employment service essentially provides low-skill workers to business. The jobs that get listed there are the low-skill jobs. The ones for which there skill requirements will go through the private employment services.

In the European countries that is not the case, and the private employment services are subordinate. They do have private employment services. There might be specific needs that would be very difficult to meet on a national basis, but they are clearly sudordinate to the public employment service.

Mr. **Walgren**. Mr. MacKay.

Mr. **MacKay**. I have been trying to think that through, and it seems to me that the perceived tension that you would get into with the private employment agencies here saying, "Look, you're trying to run us out of business," could be dealt with by essentially allowing them to subscribe to the Government. All the Government would do would be to run the central data bank——

Dr. **Appelbaum**. Right.

Mr. **MacKay** [continuing]. And on a user fee basis.

Dr. **Appelbaum**. Right, and the public employment service could offer the counseling and the relocation services, which the private employment agencies do not do.

Mr. **Walgren**. I am sure it would make many people very nervous, though.

Dr. **Appelbaum**. I agree.

Mr. **Walgren**. Please continue.

Dr. **Appelbaum**. With respect to the public schools, if I am going to have extra time, then I would like to say something. I do some consulting for the public schools in Philadelphia. One thing I have discovered is, in fact, the counselors are very interested in the vocational education issues. I did do a study of student needs, and somebody else did the manpower part, and we tried to put it together.

When we interviewed the students and asked them what they considered to be the most reliable and important source of job information, we found that we could not ask any questions about income, but we could ask about occupation. Those students who came from families where the wage earners had occupations that were skilled, and so on, learned about their future from their families or from friends of their families. However, those students who came from families where the wage earner either was unskilled or there was no wage earner, relied very heavily on their counselors for job information. They relied very heavily on assembly programs and the vocational counselors.

We thought that we would get very negative responses from the students as to how they felt about the vocational counselors. Could they go in and speak to them? Had they seen them about anything other than discipline, and so on? On the contrary, we got very positive responses. They felt that this was a source of information.

We went back to the counselors with that and said, "Hey, listen, you have a responsibility now. These kids are relying on you. They do listen to what you say. They are paying attention." I do think the Philadelphia schools have made some use of that.

While we are talking about schools—in reference to one question you asked earlier—there is something in Philadelphia that I think should be promoted and should expand. We have something called the Academies program. At the moment, it affects 600 children—if we could only make it affect 6,000 or 600,000.

What happens in this situation is that a consortium of businesses in a particular area—the very first one was an electrical academy, and this was not only the Philadelphia Electric Co., but it was the electricians' union, it was whatever companies might have an interest in having student skilled in electrical trades. It was located in what I think I could say unequivocally was the most impoverished school and the school with the lowest reading scores, and so on. The academy was physically located there.

The students were told that they would have the opportunity to work. If they completed the program successfully, which included learning reading, and writing, and arithmetic as well as the job skills, there would be a job for them. This was a major motivating factor. There was a very high graduation rate. About 80 percent of the students are placed in jobs.

It seems to me that it is very easy to solve the educational problems, if you promise the kids a job at the end, if they do a good job in school. I think that takes care of a lot of difficulties. That was just a side point.

One of the things I wanted to talk about was the persistence of structural unemployment. I believe I have made that point.

The other point has to do with high tech and the quality of jobs. I am not going to repeat the numbers—of course, there are some optimists here, and Mr. Brinner would have a different opinion—but you have had in testimony already some ideas of the order of magnitude of numbers of jobs that are going to be created by high tech. I do not want to deal again with that issue.

Instead, I want to consider the impact of the changing industrial base and the small size of the high-tech industry on the occupational distribution in this country, because I foresee a serious problem in terms of occupational distribution.

My view of the labor market is that it is segmented, that there is a primary labor market in which there are good jobs and acceptable jobs, and there is a secondary labor market in which there are poor jobs. When you look at the growth of the high tech sector, what you observe is the growth of both good jobs and poor jobs. It is not just good jobs that are growing, and I think that probably has already been said.

If you look at the computer and data processing industry, for example, you find that 37 percent of the jobs in this industry are, in fact, good jobs. However, another 32 percent are clerical jobs, two-fifths of which are data entry clerks—low wage, dead-end kinds of work. If you look at a high-tech service industry, you see that. If you look at a high tech manufacturing industry, like semiconductors—I am limited to these two because these are the two that BLS surveyed—if you look at the semiconductor industry, you find that 28 percent of the jobs are what you would call good jobs—technical, administrative, and so on. Nine percent of the jobs, on the basis of wages paid, would fall in the middle of the income distribution. Only 9 percent of the jobs in semiconductors hit the middle third of the income distribution. Sixty-three percent of the jobs in semiconductors pay wages that would put you in the bottom third of the income distribution.

When you look at a manufacturing industry like semiconductors, you see 28 percent good jobs, 63 percent poor jobs, 9 percent in the middle.

If we look at the high tech user industry, what do we see? If you look at high tech user industries in manufacturing, I think that what you see is job displacement. I am speaking now over the next 10 years. I cannot see what is coming after that. It is possible that many new products will come along that we cannot even imagine now.

If your perspective is over the next 10 years and you look at the manufacturing industries—if you look at autos, and if in fact the robots are put in place, the W. E. Upjohn Institute for Employment Research has been quoted as predicting that something like 3,000 to 5,000 jobs producing and maintaining robots will be created in the auto industry, and 30,000 to 50,000 will be displaced. I think when you look at manufacturing, those are the kinds of numbers that you see.

The assembly jobs are moving rapidly. Apple, Wang—they have a lot of assembly work overseas. Hewlett-Packard has announced it expects its overseas labor force to grow more rapidly than its U.S. labor force, and everybody knows about Atari.

I think in manufacturing we are losing jobs.

If you look at the high tech user industries in the service sector—and here I have in mind the office industries such as insurance and banking, and maybe Government; I have not looked at Government, but I have looked at insurance—in these industries we have had ongoing technological change for the last 20 years. Despite the low measured productivity growth in the last 10 years, the insurance industry has been implementing high technology at a rapid rate over the last 20 years.

The effect has not been to slow the growth of employment. Employment growth in the insurance industry has continued apace. It has not slowed at all. What you do see is a shift in the occupational distribution.

Before I looked at the numbers—I have to admit—I expected to see women displaced by office automation. On the contrary, I discovered that the proportion of women in the insurance industry has increased from 53 percent in 1960 to 61 percent in 1980. Something that I did not expect has happened.

What has happened is that office automation has led to slower growth of clerical workers; that is true. We have had absolute declines in the insurance industry in the number of bookkeepers, stenographers, typists, file clerks, and keypunch operators. These have gone down. However, we have, at the same time, had tremendous increases in the number of insurance examiners, adjusters, underwriters, and so on. These are jobs that previously were predominantly male. They are now predominantly female. Women have entered into these occupations as they have become more systematized through the use of computers.

If you look at what that means in terms of the occupational distribution, what do you see? There is plenty of opportunity for women; that is true. However, the jobs that have been shrinking are the ones that required a high school education. To be an insurance examiner, adjuster, or underwriter requires a minimum of 2 years of college. I can assure you that most new hires have a college degree and are computer literate. This has been an upgrading of skills for the women involved. There is no question that the jobs in the insurance industry for women—if you look at them in terms of skill requirements—are superior to the ones that were there before. That is one point.

The other point is that if you look at jobs for high school graduates, what do you observe? You observe they are shrinking in absolute number. That is the point I want to emphasize.

As far as I can see, looking into the next 10 years, the middle of the occupational distribution is what is shrinking. You have an expansion of good jobs at the top. You have an expansion of poor jobs at the bottom. This is not necessarily in high tech, but health services, restaurants. Occupations in these industries continue to be growing occupations. High tech has not affected them very much.

Someone has already pointed out—the union representatives pointed out—the growth of poor jobs in the economy. That, I think, is accurate. There is a growth of poor jobs in the economy. There is a growth of good jobs in the economy. What is shrinking are the opportunities in the middle. I view that as a serious problem.

The second thing that no one seems to have said here is when you look at these changes in the occupational distribution, what is growing are jobs for women and what is shrinking are jobs for men. Employment growth is coming in industries that are predominantly female. The displacement is coming in industries that are predominantly male. We are going to have to do something about our attitudes and our mores, or we are going to have a hard time adjusting to the changing industrial base.

I did have something else I wanted to say about this. Having talked about the occupational distribution, I want to talk about management strategy. We have heard a lot about competition here, but I want to talk about management strategies for adopting new technologies that have—not all companies are doing this—that could have a negative impact on employment opportunities in terms of the structure of opportunities, not the number.

When companies make a choice about implementing technology, there are always tradeoffs that have to be made. They are making important decisions with respect to machine design and job design, and there are major tradeoffs here. The tradeoff comes when decisions are made about designing the jobs in such a way that you have complex tasks that have to be done. One possibility is to design jobs in which the tasks are complex. You require skilled workers. Your initial labor costs are going to be higher, but what you gain from this is the possibility of long-run productivity gains through what economists call disembodied technological change.

If you have a skilled labor force and complex tasks, you have opportunities for on-the-job training; you have opportunities for decentralization because you have an intelligent and trained person who is capable of making decisions in the field. If you are looking at an industry such as the machine-tool industry, where this is one of the places these choices have to be made, you can design less immutable man-machine configurations. You can put less into the machine because you still have the skilled man who can think about what to do.

If in the machine-tool industry, for example, we implement the new technology by retraining machinists so that they become machinist-programers; then the machinery, the actual equipment, does not have to be able to make every little piece you need. If you need a special little piece, you tell your machinist, "Hey, listen, make this special little piece." You still have a master machinist on the job.

If you implement the technology in the other way, so that you put as much of the skill into the machine as possible, then you can replace your master machinist with a machine tender, essentially somebody to look after the machine. There is very little opportunity for learning by doing. There is very little opportunity for on-the-job training. Your man-machine configuration is inflexible. The technology you have today is what you are going to have in 10 years, and maybe even in 20 years. If you look at our steel mills, you can see how long they hang around.

The problem is that if you put the skill into the machine, you are undermining the possibility for long-run productivity growth. You get the cost saving on wages initially and lose it in the long run on productivity growth. You see what the tradeoff is. If you implement the technology in such a way that you have complex jobs, you are going to require skilled workers. Your initial labor costs will be higher, but there is the possibility of long-run productivity growth. The alternative is to put as much of the skill as possible into the machinery and start out with a less skilled labor force. This saves you lots of money on labor costs initially, but it has negative implications for long-run productivity growth.

To the extent that businesses adopt the second strategy—not thinking about the productivity aspect of it, but just with a view exclusively on the bottom line in a short-run sense—we are going to have the expansion of poor jobs at the expense of good jobs. I have given you an example in the machine-tool industry.

Another example I could draw from is the insurance industry. The thing about the insurance industry is that you have the possibility of upgrading the jobs through the technology, as I have described. That is the way it is going in most firms.

However, there is a small number of carriers that have set up satellite offices in the suburbs to take advantage of educated married women, and their employment is in the part-time labor force;

at below average wages; with no fringe benefits, including no insurance protection, even though they are working in the insurance industry. The reason this is possible is because telecommunications allow for instantaneous communication between the satellite office and the central office. Therefore, the technology can be implemented in such a way that it downgrades jobs and increases the number of poor jobs.

I do not have anything specific to recommend. I wish I had some proposals to make. I do not have proposals here. However, we need to think about encouraging firms—setting up an environment in which productivity is adopted in such a way that we have complex tasks, we retain our skilled workers, and we have the possibility of long-run productivity growth.

Thank you.

[The prepared statement of Dr. Eileen Appelbaum and supplementary materials follow:]

TECHNOLOGY AND EMPLOYMENT: FUTURE CONSIDERATIONS

Testimony of

DR. EILEEN APPELBAUM

Mr. Chairman, I am pleased to have been invited to speak at this joint hearing on technology and employment. I have been asked to comment on testimony presented at earlier panels during these hearings as well as to address the future effects of technology on the workforce and the workplace. My written testimony includes two recently completed papers on this topic titled respectively " 'High Tech' and the Structural Employment Problems of the Eighties" and "The Future of Work: Expectations and Realities." I would be happy to answer questions on these topics during the discussion period. What I would like to do in the ten minutes allotted for my oral remarks is to address some of the issues raised in earlier testimony. In general, the quality of the testimony was quite good. Rather than critique it, therefore, I shall use my time to raise what I regard as important omissions--points that need to be considered in discussing the effects of technology on employment and the quality of work.

Technological Change and Structural Employment Problems in the Recent Past and Present

Earlier testimony described three great revolutions in production--the agricultural revolution, the industrial revolution, and the information revolution. The implication seemed to be that the agricultural revolution had been completed long ago and that there has been a natural progression with displaced agricultural workers absorbed into the manufacturing sector during the industrial revolution, and with every reason to believe that displaced manufacturing workers will be absorbed into the service sector during the information revolution. This is a dangerous misconception. The reality is that major applications of technological innovations in cotton and sugar production in the American South were made after World War I and completed as recently as 1950. The decline of the agricultural labor force to about 3.5 million workers, 3 percent of the total U.S. workforce, is thus a recent phenomenon. In my view, the roots of black poverty today can be traced back to this round of economic development--to the displacement of agricultural workers by machinery and the subsequent failure of a growing economy to reabsorb significant numbers of those left jobless by changing labor requirements. The recent history of displaced black workers cautions against dismissing the displacement of blue collar workers in the Great Lakes and Northeast regions of the country as temporary adjustment problems which the market can be relied upon to resolve.

While good measures of the ability of the economy to reabsorb displaced workers do not exist, there is some evidence of structural problems, though the evidence is suggestive rather than definitive. First, duration of unemployment has increased. BLS figures indicate that the number of workers unemployed more than six months increased from 550,000 workers (0.4 percent of the labor force) in 1979 to 2.3 million workers (2.1 percent of the labor force) in 1982. Of course, unemployment in this period is cyclical as well as structural, reflecting the effects of the Carter and Reagan recessionl A better indication of the increase in structural unemployment may be the increase in the rate of unemployment at the peak of the business cycle. Thus, unemployment at the cyclical peak prior to the 1969-1970 recession was 3.4 percent, prior to the 1973-1975 recession it was 4.8 percent, prior to the 1980 recession it was 6.0 percent and prior to the 1981-1982 recession it was 7.4 percent. Cyclical peak unemployment more than doubled over the last decade and a half. The current recession is expected to bottom out at an even higher level. Earlier testimony based on an econometric model of the U.S. economy projected an increase of about 1.3 percent in the unemployment rate if new technology is introduced and productivity increases more rapidly over the next decade than it did in the last. An informed reading of current economic events suggests to me that this is correct. But this increase will bring the total unemployment rate above 8 percent. The problem is not massive unemployment as a result of advancing technology, but a further rise in the unemployment rate that brings unemployment at the cyclical peak (when unemployment is at its lowest point over the business cycle) to unacceptably high levels. This evidence from unemployment data suggests that the growth in service sector employment has not, by itself, resolved the structural unemployment problems despite the fact that between 1947 and 1982 the number of service jobs increased from 5 to over 19 million, with most of the increase coming in the last decade.

The Role of Labor Market Policy

The restructuring of employment by industry and occupation occurred not only in the U.S. but in Japan and Western Europe as well. The U.S. was, perhaps, better off than other developed countries because it experienced more rapid overall employment growth in the 1970s. Japan and Sweden grew at half the U.S. rate while employment in other countries stagnated or decreased. Even manufacturing employment in the U.S. increased slightly in the 1970s, whereas in countries like Japan, Germany, France and the U.K. it declined. Yet U.S. unemployment rates during that decade were double or triple those of other OECD countries except the U.K.. Even granting the differences in the measurement of unemployment, it appears that other countries have been more successful in accommodating to employment changes resulting from changes in demand and/or in technology, and have achieved this success despite a more adverse overall employment situation than that which faced the U.S..

What accounts for this greater difficulty in dealing with the adjustment problems of displaced workers in the U.S.? The U.S., unlike Western Europe and Japan, lacks both vocational training programs and help with relocation and reemployment through the public employment service for displaced primary sector workers. These weaknesses are especially glaring today as programmable automation technologies, compounded by increasing imports of steel and autos, dislocates such workers. Very little exists in the way of public policy (apart from income maintenance programs like unemployment compensation and trade readjustment assistance) to deal with such dislocations. Moreover, the job training component of CETA programs has been steadily eroded. By the late 1970s, 95 percent of CETA enrollees were disadvantaged urban workers. The emphasis of the program at that time had shifted from providing training for jobs to public service job creation programs. By 1980, training represented only 16 percent of CETA expenditures. Thus, whether the focus is on the training of disadvantaged workers or on the retraining of displaced primary sector workers, U.S. labor market policy has been deficient.

The Job Training Partnership Act of 1982 introduces several changes in the approach to employment and training. In addition to shifting administration from government to business, it gradually eliminates public service employment, limits financial support to trainees, and provides matching funds to states that establish retraining programs for dislocated workers. The provisions appear likely to reduce the help available to disadvantaged workers, but they also introduce the possibility of training programs for primary sector workers. It is too soon to tell whether the states which are hardest hit will be able to take advantage of the provisions of the act. In any event, labor economist Michael Podgursky has shown that the federal government was spending nearly four times as much for training per unemployed worker in 1970 as today. He concludes that cuts of such magnitude preclude any major new initiatives in training disadvantaged workers or in retraining displaced workers.

It seems clear to me that much structural unemployment--whether it is the residual unemployment left over from the revolution in agriculture or the new unemployment resulting from the spread of robots and information processing technologies--could be eliminated, as it has been in other OECD countries, through an active labor market policy with emphasis on vocational education and training.

Job training is the most important component of an active labor market policy, but not its only component. I believe that the public employment service is an institution which, if properly utilized, could greatly facilitate labor mobility between regions and assist dislocated workers in one area to find employment in another. The problem with the U.S. Employment Service is that in comparison with such agencies in other countries in Europe it lacks the power to fulfill its mandate. In other OECD countries, the public employment service is given, by law, the preeminent position in the labor market. Employees seeking to work are required to register with the agency, employers are required to list vacancies, counseling services are provided, access to training programs is through the public employment service, and the service is generally empowered to provide relocation and job search assistance for workers looking for jobs in other regions. In recent years the U.S. Employment Service has made some improvements. One important innovation has been its computerized job bank. However, it has limited resources and lists only a small proportion of job vacancies.

I am optimistic about the possibility of improving allocative efficiency with respect to labor resources and reducing unemployment through active labor market policies, although I do not believe that such policies will be sufficient to achieve John Kennedy's goal of 4 percent unemployment. The European and Japanese experience suggests to me than an active labor market policy along OECD lines--using vocational training programs and relocation, labor market information and job search assistance through the public employment service--can succeed in facilitating structural change and, hence, in reducing unemployment. Economic efficiency would, of course, be improved since retraining and relocation of displaced workers would enable the economy to more fully utilize its labor resources.

"High Tech" and the Quality of New Jobs Created During the Next Decade

It is evident that labor markets in the U.S. are segmented into a primary labor market segment in which most of the 'good' or 'acceptable' jobs are located, and a secondary segment in which most of the 'poor' jobs are to be found. A further distinction can be made between autonomous primary segment jobs (professionals like doctors or craftsmen like electricians) and subordinate primary segment jobs (mail carriers, insurance adjustors, steel workers, etc.). The difference between a subordinate primary segment job and a secondary segment job is sometimes based on worker skills and sometimes on non-skill related job characteristics. The better jobs are those in which the employer values steadiness and low turnover and is willing to reward tenure on the job with promotions and higher pay, or in which the employee is represented by a union that has won decent wages, a pay scale that rewards seniority, and protection against arbitrary treatment.

The growth of the high tech sector has provided both good jobs and poor ones. In the computer and data processing services industry, a BLS study showed that 37 percent of the non-supervisory employees are highly paid professional or technical workers. At the same time, however, the survey found that office clerical employees account for another 32 percent of employment. Two-fifths of the office clerical employees are key entry operators earning low wages. The point is that high tech employment, like employment generally, is two-tiered; and the growth of high tech services has provided both good jobs at the top and dead end clerical jobs at the bottom. Most jobs in high tech manufacturing firms are not high tech jobs, and many are not even very good jobs. Thus, a BLS survey of the semiconductor industry found that 58 percent of the employees are plant workers, 14 percent are office workers, and 28 percent are administrative, executive, professional, scientific and engineering employees. If the jobs are classified on the basis of wages paid, 28 percent of the jobs were good jobs in the top third of the income distribution, only 9 percent were in the middle, while 63 percent were in the bottom third of the U.S. income distribution. Low wage production jobs in Silicon Valley are poor in other respects as well--they are tedious and they expose workers to health hazards.

Looking beyond the high tech sector to traditional industries, employment growth through the end of this decade is expected to continue the pattern of the last decade. It will occur in office industries like insurance, in retail trade including restaurants and fast food, and in health services. New jobs in retail trade and health services are mainly jobs for women which provide short hours, little opportunity for advancement, and low wages. Thus many new employment opportunities in the next few years will be found among poor jobs in the secondary labor market. New jobs in industries like insurance are also mainly for women, but here the spread of office automation and information technologies has resulted in the expansion of jobs with increased skill requirements. In the U.S. insurance industry, office automation has resulted in slow growth in clerical employment, with substantial declines in the numbers of typists, stenographers, keypunch operators, bookkeepers, and file clerks. Yet total employment has increased and the proportion of women in the industry has grown from 53 percent in 1960 to 61 percent in 1980 as the proportion of female insurance adjustors, examiners, and underwriters has risen. The traditional female jobs in which employment has decreased, while not necessarily unskilled, required skills taught in high school. The new jobs require a minimum of two years of college and most new hires are college graduates who are computer literate.

The effect of the adoption of new technologies on employment in high tech user firms differs for service industries and for manufacturing industries. The evidence clearly indicates that job displacement in manufacturing will much exceed job creation. In services, however, the impact to date has been on the occupational distribution rather than on aggregate job creation. It is difficult to determine whether this will continue into the future. European studies indicate that the cumulative effects of automation in office industries will reduce the number of jobs. Comparable studies for the U.S. have not been undertaken.

Impact on the Occupational Distribution

Two major implications emerge from this discussion. First, employment growth is occurring in industries in which the majority of employees is female, while declines are in industries that predominantly hire males. The sex stereotyping of jobs increases the difficulty of adjustment to the changing industrial base.

Second, changes in technology and the shift to service sector employment are eroding the middle of the job distribution, making the labor market more starkly two-tiered with good jobs at the top, poor jobs at the bottom, and shrinking opportunity in the middle. Well paid, stable employment in basic manufacturing industry for men and traditional clerical employment for women filled the middle of the occupational distribution. These are the jobs that are contracting. The contraction of the middle of the opportunity structure is a treacherous employment problem which will emerge in the developed countries over the coming decade.

Management Strategies and the Quality of Employment Opportunities

Management strategies for implementing new technologies will have a major impact on the quality of new jobs. Consider the insurance industry. Educational requirements for new workers are increasing. It is tempting to conclude that compensation will increase along with productivity and that the quality of jobs will improve. While this is likely to happen, it must be noted that a small number of insurance carriers have set up satellite offices in the suburbs and hired educated married women as a part time labor force—at below average wages, without fring benefits, and without opportunities for advancement. Telecommunications technology provides the instantaneous connection between the satellite and central offices that makes possible this downgrading of what should have been good jobs. A second example can be drawn from the machine tool industry. As firms in this industry adopt programmable automation technologies they have the opportunity to substitute machinery for skill, thus making possible the substitution of less skilled workers for skilled master machinists. If they choose this option in order to save on wages, poor jobs will expand at the expense of good ones.

This example helps to make yet another point: If firms concentrate exclusively on the bottom line, there will be an incentive to downgrade a substantial number of primary sector jobs. However, such a strategic approach may prove to be short sighted, and may have negative impacts on the long run competitive position of firms that reduce their skilled labor force. In the machine tool industry example firms that substitute machinery for skill have to adopt a man/machine configuration that is more permanent and less flexible. With fewer skilled master machinists, the opportunities for learning by doing are severely curtailed. In contrast, those firms that retain their master machinists and retrain them for positions as machinist/programmers need to build less into the machine, can design less immutable man/machine configurations, have enhanced opportunities for learning by doing, and have increased opportunities for continuous technological change. In the long run, productivity growth and competitive advantage reside with the firms that adopt this strategy.

The Role of Public Policy

It is much more difficult to design public policies that affect the quality of jobs than to design those that affect the level of employment. Public and private programs to upgrade training and education, improve the quality of the nation's public schools, and strengthen our colleges are an essential and welcome means of providing workers with the knowledge and skills to gain entrance to upper tier jobs and to overcome occasional shortages of technically trained personnel. But such programs should not be viewed as a panacea. By themselves, such programs are inadequate and cannot eliminate the emerging structural employment problems. Excessive reliance on such programs is predicated on the false assumption that if workers are educated, there will be enough good jobs to go around. The evidence indicates that much new job growth will be in poor jobs in low skill occupations in distinctly low tech industries. To solve the structural problems, programs to improve the education and training of workers will have to be linked to programs to transform the characteristics of poor jobs. Intense application of anti-discrimination policies will also be required since, in addition to education, race, sex and social acceptability continue to be important determinants of who gets the good jobs.

The choices with respect to machine and job design made in the coming decade by high tech user firms will affect the quality of employment opportunities, the potential for human capital development, and the rate of productivity growth into the next century. Public policy and societal norms in the U.S. should be directed toward providing an environment conducive to a pattern of technical development that favors complex jobs and long run productivity gains. (The tradition of life time employment of workers in Japanese firms in the technologically progressive core industries, for example, favors such a pattern, since it rules out the possibility of economizing on direct labor costs in the short run.) Management in U.S. firms tends to favor economizing on direct labor costs, and seems insufficiently aware that these short run savings are achieved at the expense of future productivity gains. While I am unable to be specific, I would favor policies that encourage and enable firms to take the longer view.

THE FUTURE OF WORK: EXPECTATIONS AND REALITIES

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THE FUTURE OF WORK: EXPECTATIONS AND REALITIES

It is widely believed that technological developments in computers, microprocessors, and telecommunications constitute an extension of the industrial revolution capable of fostering full employment and a rising standard of living in the U.S., Canada, and Western Europe. Investment in these technologies is confidently expected to reverse the dismal economic performance of the 1970s, and to provide an abundance of new jobs that make productive use of the skills of a well-paid, educated labor force. The reality may prove to be very different. Over the next ten years "high tech" industries in the U.S. will probably generate a million additional jobs, less than half the number of manufacturing jobs lost here in the last three years. Moreover, job growth will come at the top and the bottom of the occupational distribution while opportunities in the middle shrink. Ill-considered management strategies for implementing new technologies may exacerbate the growth of poor jobs, reduce productivity growth, and have a negative effect on the quality of ~~jobs~~ work into the twenty-first century.

Optimistic Expectations

The technological optimism that underlies public belief that a "high tech" approach to reindustrialization and renewal will usher in another golden growth age has a distinctly Schumpeterian cast. It was Schumpeter who argued that there are long waves in economic activity whose timing is closely related to the implementation of major innovations in a few industries followed and complemented by innovations in other industries that are "drawn along." Thus the Industrial Revolution (1787-1842) was succeeded by the Age of Railroads, Steam and Steel (1843-1897), which ended in the depression-wracked decade of the 1890s. This was followed, in 1898, by the Second Industrial Revolution which Schumpeter suggested was based on innovations in electricity, motor vehicles, and chemistry. Electricity, which had a previous commercial history, became significant only after the introduction of long-distance transmission, electrochemistry, and electrical steel production. It had its major impact on industries "downstream" from it--spawning industries that produced cables, bulbs, and electric appliances, and altering the nature of the machine industry. Innovations in chemistry included the development of synthetic fibers, dyes, and pharmacological products. The capital requirements and contributions to output of the chemical industry were great, but its role as an employer of labor was modest. Motor vehicles had the greatest impact on the expansion of the U.S. economy, with the automobile industry pacing the growth in national income and employment in the first three decades of this century. The automobile industry not only contributed directly to the growth of GNP, but drew along numerous other industries both "upstream" and "downstream" in which output expanded and innovation occurred, including iron and steel, copper, nickel, oil, rubber, plate glass, leather, road and housing construction, and cement.

To some observors, the stage appears set for a third industrial revolution based on innovations in semiconductors (microprocessors), computers, and telecommunications, sometimes designated the Information Revolution. Yet important questions remain unanswered, the most urgent of which must surely be whether new technology can sustain high levels of employment as well as high rates of productivity growth, and whether it will generate stable, high wage jobs. In the current bleak unemployment context one could postulate a dark view of economic affairs in which a significant proportion of male manufacturing workers in the developed countries remained outside the economic mainstream and in which real wage gains lagged far behind technologically induced increases in labor productivity.

The technological enthusiasts, whose ranks include most economists, concede the importance of structural changes in the short run, but are sanguine about the long run prospects because of their confidence in the following sequence of events: (1) New technology is implemented. As a result, (2) productivity and household income both increase. With household incomes rising, (3) consumption increases and households demand both increased quantities of previously provided goods and services and the provision of new products to meet new or newly-discovered needs, many of them conditioned by the new technology itself. The final result is (4) economic growth, new sources of employment, and widespread prosperity.

Historical experience with the railroads, the telephone, and the automobile provides a basis for the professional optimism of economists, but blind confidence in this sequence of events in present day circumstances does not seem warranted. The increased internationalization of the economies of the developed countries may impose external limits to the achievement of full employment and rising compensation rates. The changing pattern of imports and exports in the developed countries, together with the diffusion of robots and other programmable automation technologies, may result in a secular increase in unemployment among some segments of the manufacturing labor force. The simultaneous deskilling and feminization of diverse occupations as the new technology diffuses, the shift from producing steel to producing hamburgers, and the decline in employment in high wage, unionized industries suggest that household incomes and consumption may not keep pace with increases in productivity. The economists' fortuitous sequence of events would then be interrupted by persistent structural problems of unemployment and slow wage growth.

Confidence in a causal relationship running from "high tech" to full employment and a rising standard of living requires that the links between technological developments and employment growth be elaborated. Specifying these links, that is, analyzing the dynamic implications of the information revolution, is by its very nature a difficult speculative exercise. The enormity of such an exercise can be grasped by imagining an attempt to predict the dynamic economic implications of the telephone in 1886, ten years after its invention, or of the automobile in 1915.

Here we shall attempt a more modest task: an examination of the available evidence in order to discern the relationship between "high tech" and employment--the reality of work--for the next ten years. The future of work in the twenty-first century, as I shall argue in my concluding remarks, depends very much on the management strategies for implementing new technologies adopted in the next decade.

The Job Creating Potential of "High Tech"

High technologies are popularly identified with the technologies of information processing, communications, semiconductors, robots, and biotechnology. A more precise definition can be obtained by reserving the "high tech" designation for those industries with above average R&D expenditures (9.6 percent or more of investment for U.S. industries) and/or high levels of scientists, engineers, and technical employees (13.7 percent or more for U.S. industries). This definition encompasses 25 U.S. manufacturing industries--including computers, communication equipment, electronic components, laboratory instruments, aircraft, space vehicles, drugs, industrial chemicals, and plastics--as well as such service industries as computer programming, data processing, and research laboratories.

Surprisingly, in view of the general perception that high technology has been a major source of employment growth, high tech manufacturing industries did not fare better than other manufacturing industries in providing new jobs for U.S. workers in the last decade. Between the cyclical peak years 1969 and 1979 employment in industries with above average R&D expenditures grew 4.5 percent while employment in industries with high levels of scientific, engineering, and technical personnel grew 2.0 percent. These growth rates do not differ much from employment growth in all manufacturing, which measured 4.2 percent over the decade; and compares unfavorably with the growth of total employment which increased 27.6 percent. It should be noted that a subset of the high tech manufacturing industries with both high R&D expenditures and high levels of scientific, engineering and technical workers did experience a 26.3 percent growth rate. However, these industries together added only 444 thousand new jobs, 2 percent of the 19 million jobs created during the 1969-1979 decade.

Looking to the future, Data Resources Inc. estimates that the number of new high tech manufacturing jobs created between 1983 and 1993 will be substantially less than half the 2 million jobs lost in manufacturing in the last three years. Rapidly rising productivity as the high tech companies automate, often using their own products to do so, combined with the small size of the high tech manufacturing sector (4.7 million manufacturing jobs in 1979) limits the ability of this sector to provide employment. Moreover, assembly jobs in high tech industries are subject to competition from low wage labor, particularly in Third World countries like Malaysia, Taiwan, the Phillipines, and Mexico where assembly workers earn as little as 50 cents an hour. Thus, Atari decided in February to move 1700 assembly jobs from California to Asia, Apple Computer and Wang Laboratories have turned to the Far East for substantial preliminary assembly work on computer components, Hewlett-Packard predicts that its overseas work force will grow faster than its U.S. workforce when major plants in Mexico and elsewhere are completed. These jobs follow others implanting metal pins into computer chips for high tech companies such as Intel and National Semiconductor which moved to Asia long ago.

Furthermore, the number of additional jobs in high tech manufacturing industries will, in part, be offset by the number of jobs lost to robots and other programmable automation technologies in traditional industries such as steel and autos. The W.E. Upjohn Institute for Employment Research estimates that the number of robots working in the auto industry will increase from 2,400 to between 15,000 and 25,000 by the end of the decade. It is expected that 3,000 to 5,000 jobs will be created producing and maintaining the robots, while the robots will replace 30,000 to 50,000 auto workers.

High tech service sector industries exhibit a rapid rate of employment growth, but the small size of the sector limits the total number of jobs created. Thus, the U.S. computer and data processing services industry, largest of the high tech service industries, added only 300,000 jobs since 1969. New jobs created by the sector as a whole number under 400,000. Office automation may slow future growth of clerical employment in this industry. Diffusion of technological advances such as on-line processing and optical character recognition may result in a decline in employment in occupations such as data entry clerk and key punch operator by 1993. Overall, employment will probably not increase by more than 300,000 by that date.

While employment growth in high tech user industries in the manufacturing sector is expected to be negatively affected by automation, the impact on employment growth in high tech user industries in the service sector is difficult to evaluate. European observors expect the cumulative effects of information processing technologies and office automation techniques to substantially reduce the growth of employment in the office industries--insurance and finance. Comparable studies for the U.S. do not exist. There is some evidence from aggregate data on the insurance industry that the introduction of technology has altered the distribution of occupations within the industry but has not slowed the rate of employment growth. To a large extent this is due to the introduction of new services. In part, productivity growth has taken the form of better performance and higher quality services rather than a reduction in labor requirements. As a result, it is probable that employment growth in service sector user industries will continue apace through the next decade.

The Quality of Employment Opportunities

The analysis of the previous section focused on aggregate employment possibilities. To discuss the qualitative aspects of the new jobs being created--within the high tech sector and downstream, within traditional industries that utilize high tech products and services--requires that we turn our attention to how labor markets are structured.

It is evident that labor markets in the U.S., Western Europe, and Canada are segmented into a primary labor market segment in which most of the "good" or "acceptable" jobs are located, and a secondary segment in which most of the "poor" jobs are to be found. A further distinction can be made between autonomous primary segment jobs (professionals, like doctors, lawyers, and professors, or craftsmen like plumbers, electricians, carpenters) and subordinate primary sector jobs (mail carriers, insurance adjustors, steel workers, etc.). The difference between a subordinate primary sector job and a secondary sector job is sometimes based on worker skills and sometimes on non-skill related job characteristics. The better jobs are those in which the employer values steadiness and low turnover and is willing to reward tenure on the job with promotions and higher pay, or in which the employee is represented by a union that has won decent wages, a pay scale that rewards seniority, and protection against arbitrary treatment. Many of the subordinate primary sector jobs available for male workers are to be found in the goods producing sector of the economy, where workers have more union representation than in the service sector.

The growth of the high tech sector has provided both good jobs and poor ones. Producer services (advertising, architecture, law, management consulting, computer and data processing, financial) now account for 19 percent of GNP, and high tech firms in this industry have been a major source of good jobs. This observation is confirmed by the Bureau of Labor Statistics (BLS) study of the computer and data processing services industry. The BLS survey found that approximately 37 percent of the non-supervisory employees in this industry are highly paid professional or technical workers, many of them computer systems analysts, computer operators, and computer programmers. At the same time, however, the survey found that office clerical employees account for another 32 percent of employment in this industry. Two-fifths of the office clerical employees are key entry operators earning between $3.86 and $5.86 an hour in 1978. The point is that high tech employment, like employment in the U.S. generally, is two-tiered. The growth of this sector has meant an increase in professional, technical, and managerial jobs at the top; but it has also meant an increase in clerical, sales, and nonprofessional service jobs at the bottom.

It's not news that most jobs in high tech manufacturing industries are not high tech jobs, but it may be surprising to learn that many are not even very good jobs. BLS surveyed the semiconductor industry, which currently employs 237,000 workers. Of the workers employed in this industry, approximately 58 percent are production workers and 14 percent are office workers. The remaining 28 percent are administrative, executive, professional, scientific and engineering employees. More than 60 percent of the plant workers are assemblers, crystal processors, or inspectors; and nearly half of these are women. Computer operators and engineering technicians, most of whom are men, account for 40 percent of the office employees; the rest are general office clerks and secretaries. Average earnings of plant workers in 1977 ranged from $3.38 an hour for crystal coaters (90 percent female) to $7.94 for maintenance pipe fitters (100 percent male), while the highest paid engineering technicians (100 percent male) earned $8.41. A wage below $6.00 an hour placed a U.S. worker in the bottom third of the income distribution in 1977, while a wage above $9.50 placed that person in the top third. On that criterion, 28 percent of the jobs in this industry were good jobs at the top of the distribution, 9.2 percent were in the middle, while 62.8 percent were low paying jobs. Low wage production jobs in Silicon Valley are poor in other respects as well--they are tedious and they expose workers to dangerous occupational health hazards.

Looking beyond the high tech sector to traditional industries, employment growth through 1993 is expected to continue the pattern of the last decade and to occur in office industries like finance and insurance, retail trade including restaurants and fast food, and health services. More than half the employees in retail trade and four-fifths of those in health services are women. Most of the jobs in these industries provide short hours and little opportunity for advancement, and they pay low wages. Thus many new employment opportunities will be found among poor jobs in the secondary labor market. While high tech--in the form of electronic cash registers and digital thermometers--has entered these industries, it has not altered the conditions of employment or the quality of job opportunities, nor has it increased educational or skill requirements.

More than half the employees in finance and insurance are also women, but here the analogy with retail trade and services ends. Office automation and information technologies are diffusing quickly in these industries with important implications for the quality of employment. In the rapidly growing U.S. insurance industry, office automation has resulted in slow growth in clerical employment, with substantial declines in the numbers of typists, stenographers, keypunch operators, bookkeepers, and file clerks. Surprisingly, total employment growth has not slackened. Even more unexpectedly, the proportion of jobs held by women increased from 53 percent in 1960 to 61 percent in 1980. What has happened is that as technology allowed the systematization of tasks performed by insurance adjustors, examiners, and investigators and made possible the incorporation of decision algorithms into computer programs that support insurance underwriting functions, the proportion of women in each of these growing occupations increased dramatically. Women insurance adjustors, examiners, and investigators increased from 9 percent of employees in those occupations in 1962 to 58 percent in 1981. Whether these occupations were deskilled as well as feminized is almost entirely beside the point: for women entering the insurance industry job opportunities and skill requirements have increased. The traditional female jobs in which employment has decreased, while not necessarily unskilled, required skills taught in high school in commercial and vocational programs. The new jobs require a minimum of two years of college and most new hires are college graduates who are computer literate.

Looking to the future, BLS anticipates continued growth in employment within the insurance industry for mathematical specialists, computer specialists, and other professionals (currently 6 percent of industry employment), managers and administrators (currently 12 percent), agents and brokers (currently 33 percent), and insurance adjustors, examiners and estimators (currently 11 percent). Slow growth or declines are expected in traditional clerical occupations (except secretaries) and in craft, operative, service and laborer occupations.

Two major implications for the future of work emerge from this examination of the quality of employment opportunities over the coming decade. First, employment growth is occurring in industries in which the majority of employees is female, while declines are in industries that predominantly hire males. The sex-stereotyping of jobs is deeply embedded in both labor market structures and popular culture. Such attitudes increase the difficulty of adjustment to the changing industrial base in developed countries.

Second, changes in technology and the shift to service sector employment are eroding the middle of the job distribution, making the labor market more starkly two-tiered with good jobs at the top, poor jobs at the bottom, and shrinking opportunity in the middle. The best jobs and the poorest jobs are both expanding in number. It is the young people who have succeeded in secondary school, and who enter the world of work motivated to do well and prepared to work hard, who will find it difficult to find worthwhile jobs in this emerging work environment. Well paid, stable employment in basic manufacturing industry for men and traditional clerical employment for women filled the middle of the occupational distributions for male and female high school graduates, respectively. The contraction of the middle of the opportunity structure is a treacherous employment problem which will emerge in the developed countries over the coming decade. Public and private programs to upgrade training and education and to provide for retraining are an essential and welcome means of reducing the severity of this problem. They will provide some workers with the knowledge and skills to gain entrance to upper tier jobs, and will overcome occasional shortages of technically trained personnel. But such programs should not be viewed as a panacea. By themselves, such programs are inadequate and cannot eliminate the emerging structural employment problems. Excessive reliance on such programs is predicated on the false assumption that if workers are educated, there will be enough good jobs to go around. The evidence indicates that much new job growth will be in poor jobs in low skill occupations in distinctly low tech industries. To solve the structural problems, programs to improve the education and training of workers will have to be linked to programs to transform the characteristics of poor jobs. Jobs in hospitals, nursing homes, hotels, and janitorial services are among those that could readily be restructured to provide on-the-job training, career ladders and opportunities for advancement, stable employment, and higher wages. Intense application of anti-discrimination policies will also be required since, in addition to education, race, sex and social acceptability continue to be important determinants of who gets the good jobs.

Management Strategies and the Quality of Employment Opportunities

Will business make the commitment to upgrading the quality of jobs now found in the secondary labor market? Or will business contribute to the increase in the number of poor jobs by using the very technologies which are expecte to improve the quality of jobs to transform what are now upper tier jobs into jobs in the secondary labor market? An example may serve to clarify the issue. Ten years hence the insurance industry will require a better educated work force than it did ten years ago. It is tempting to conclude that compensation will increase along with productivity in this industry, and that the quality of working life will improve. While this is very likely to happen, a jarring note is struck by the still small number of insurance carriers who have set up satellite offices in the suburbs and hired educated married women as a part time labor force--at below average wages, without fringe benefits (including health or life insurance protection), and without the opportunities for advancement available at the central office--to work as adjustors and examiners. Telecommunications technology provides the instantaneous connection between the satellite and central offices that makes possible this downgrading of what should have been good jobs.

A second example can be drawn from the machine tool industry. As firms in this industry adopt programmable automation technology they have the opportunity to substitute machinery for skill, thus reducing the skill component of the task and making possible the substitution of lesser skilled machine tenders for more highly skilled master machinists. If they choose this option in order to save on wages, poor jobs will expand at the expense of good ones. This second example helps to make yet another point: If firms concentrate exclusively on the bottom line in making strategic decisions about implementing new technologies, there will be an incentive to downgrade a substantial number of primary sector jobs. However, such a strategic approach may prove to be short-sighted and may have negative impacts on the long run competitive position of firms that adopt it vis a vis those that choose not to reduce the proportion of skilled workers. In the machine tool industry example firms that substitute machinery for skill have to adopt a man/machine configuration that is more permanent and less flexible. With fewer skilled master machinists, the opportunities for learning by doing are severely curtailed. In contrast, those firms that retain their master machinists and retrain them for positions as machinist/programmers need to build less into the machine, can design less immutable man/machine configurations, have enhanced opportunities for learning by doing, and have increased opportunities for continuous technological change. In the long run, productivity growth and competitive advantage reside with the firms that adopt this strategy. Furthermore, the decision by firms to substitute capital for skill in order to minimize initial unit labor costs and maximize short run profits has the system-wide effect of reducing the economy's potential for long run productivity growth and of limiting the growth of good jobs while promoting an increase in poor ones.

Conclusion

Firms that implement new technologies necessarily make choices among machine designs and job designs. They face a trade-off between more complex jobs, higher initial unit labor costs, and higher potential disembodied productivity increases (from improved organizational efficiency, learning by doing, superior on-the-job training sequences, and higher worker morale) on the one hand, and less skilled jobs, lower initial labor costs, and lower potential productivity increases on the other. According to Professor Peter Albin, job design in the U.S. as information processing and programmable automation technologies are adopted has tended to follow the second pattern, while in Japan it has tended to follow the first. Management in U.S. firms tends to favor economizing on direct labor costs, and seems insufficiently aware that these short run savings are achieved at the expense of future productivity gains.

The choices with respect to machine and job design made in the coming decade by high tech service firms, high tech manufacturing firms, and high tech user firms will affect the quality of employment opportunities, the potential for human capital development, and the rate of productivity growth into the next century. Public policy and societal norms in the U.S. and other developed countries should be directed toward providing an environment conducive to a pattern of technical development that favors complex jobs and long run productivity gains. (The tradition of life time employment of workers in Japanese firms in the technologically progressive core industries, for example, favors such a pattern, since it rules out the possibility of economizing on direct labor costs in the short run.) It is only in this context that joint public and business ventures to improve the quality of education and increase worker competencies will actually succeed both in supplying firms with skilled workers capable of performing complex tasks and in providing workers with satisfying jobs that make use of their skills.

"HIGH TECH" AND THE STRUCTURAL EMPLOYMENT PROBLEMS OF THE EIGHTIES

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"HIGH TECH" AND THE STRUCTURAL EMPLOYMENT PROBLEMS OF THE EIGHTIES

Economic malaise, underlined by the sharpness of the recent cyclical downturn, has been a fact of American life and a topic of national concern and debate for more than a decade. Economists have directed the attention of the profession and the public to a single dimension of the problem, the slowdown in productivity growth. Proposed solutions have focused on providing incentives for private investment in order to achieve rates of growth approximating those that prevailed from 1948 to 1968. Details of these solutions vary widely. They range from incentives for private investment to the formation of quasi-public bodies which would shore up private enterprise by implementing the investments in social overhead capital and in desirable but risky ventures that the private sector has been unwilling to undertake. Overlooked in these discussions of economic stagnation, however, has been another dimension of the crisis, as serious perhaps as the productivity slowdown: the increasing inability of private enterprise to allocate labor resources effectively to productive activity. American workers face the distinct possibility that their wages relative to the earnings of workers in other developed countries will decline. In addition, an important segment of industrial workers confronts the possibility that the economy will find their labor redundant. The initial stages of this process can already be discerned. In the absence of public policy to anticipate and plan for changes in industrial structure, Americans have had to place their faith in a new round of economic growth, powered by the expansion of the "high tech" industries, to provide comparable employment opportunities for these workers. Public policy in the U.S. has adopted a single-minded emphasis on productivity growth that ignores the problems of structural adjustment to economic change and the need for public programs to facilitate the reintegration of U.S. workers into the new international division of labor. Should the economy fail to provide employment for yet another segment of the work force, the prospects for restoring economic prosperity will be seriously jeopardized.

This chapter will document the recent deterioration in employment prospects for U.S. workers, and will examine whether new developments in "high tech" service and manufacturing industries are sufficient to reverse this decline.

II

The argument that the relative wage and employment possibilities of workers are worsening can be stated rather straightforwardly. It may be most useful to state each point in the argument as a proposition, suggesting the evidence that can be mustered in support of it, and then drawing the implications.

The slowdown in investment in the 1970s led to slower growth in capital-labor ratios and in labor productivity in manufacturing, and has given Japan an absolute advantage in several important industries.

Economists tend to hedge on the question of whether there has been an actual slowdown in investment. On the one hand, they cite the fact that non-residential private fixed investment and investment in producers durable equipment both increased as a percent of GNP during the 1970s. [1/] At the same time, they agree that the average annual rate of growth in investment in real terms has slowed substantially since the 1950s. One typical estimate is that the average annual rate of growth in business fixed investment (in 1972 dollars) slowed from 5.9 percent for the 1955-1966 period to 4.6 percent for 1966-1973, declining to 3.8 percent for 1973-1980. [2/] There is general agreement that manufacturing industry has been adversely affected. While estimates of the severity of the slowdown in investment in manufacturing differ, one respected analysis of output and productivity growth in manufacturing found a decline in the average annual growth in capital inputs from 2.4 percent in 1958-1965 to 1.8 percent in 1973-1977. [3/]

The negative impact of slower growth in investment in manufacturing has been felt in deteriorating capital-labor ratios, especially in older, capital intensive industries, and in a consequent decline in the rate of growth of labor productivity. Lester Thurow argues that the capital-labor ratio in the U.S. grew at about 3 percent per year from 1948 to 1965, but slowed after that as the baby boom increased the work force and investment failed to keep pace. Since 1978, the ratio has fallen at about 1 percent per year. [4/] With a higher ratio of investment to GNP, and lacking a baby boom, the Japanese have not only achieved higher rates of growth in the capital-labor ratio, but appear to have attained absolutely higher capital-labor ratios than the U.S. in their most modern facilities. Thus, a Japanese study of leading U.S. and Japanese firms (*i.e.*, those that rank first in value added in their respective industries) concluded that Japanese businesses outranked their American counterparts in 1977 in both capital-labor ratios and average labor productivity in four important industries in which Japan competes with the U.S. (ordinary steel, four-wheeled motor vehicles, auto parts, and chemicals), and equalled the Americans in yet another (electric machinery). 5/

American jobs in manufacturing are being lost as the U.S. thus relinquishes its competitive advantage in numerous industries including crude steel, rubber, passenger cars, zinc, cement, synthetic fibers and a wide variety of apparel industries.

Steel, autos, and rubber are the durable goods and textiles and apparel are the nondurable goods in which production and employment are believed to have fared most poorly. Brookings economist Robert Crandall argues persuasively that the cost advantage in steel production has passed decisively to the industrializing nations of Latin America and eastern Asia. 6/ Raw materials costs are approximately equal for coastal facilities in all countries with deepwater ports, the cost of building new integrated steel mills varies narrowly in countries around the world, while sharply lower labor costs ($2 to $4 an hour in 1978 dollars) in the industrializing nations has placed the U.S. at a serious disadvantage. Ira Magaziner and Robert Reich agree that wage rates at one-eighth U.S. levels and productivity levels about one-half to two-thirds those of American producers have given countries like Brazil and Korea a cost advantage in producing steel. They estimate that developing countries will produce 17 percent of world steel by 1984. 7/ They argue, however, that the more serious threat to the viability of the U.S. steel industry came from the Japanese steel industry which overtook the U.S. steel industry by improving its efficiency between 1966 and 1972. As a result of "large, well-directed capital investments and aggressive pursuit of export markets," Japanese mills have increased their cost advantage over U.S. producers despite a rise in Japanese wages relative to U.S. wages. 8/ While spending less on investment than the Japanese, U.S. industry did spend at a sizable rate. The problem, according to Magaziner and Reich, was that "U.S. steel companies made small incremental investments to obtain 'cheap' capacity rather than make the larger, more aggressive, and riskier investments that could have led to superior productivity overall." 9/ The loss of competitive advantage in steel, they argue, is the result of strategic mistakes and management failure rather than an inevitable outcome due to the operation of the principle of comparative advantage. Despite this deterioration of the U.S. steel industry's competitive position, Alice Rivlin, Director of the Congressional Budget Office, believes that there is no danger that the U.S. will lose the capacity to produce steel; but she points out that the level of steel produced by domestic mills will probably decline at an average rate of about 2 percent annually for the next two decades. 10/ This in fact is the rate at which the value of output in the steel industry has declined during the period 1966-1978. Steel imports rose steadily from 4.7 percent of apparent steel supply in 1961 to 16.2 percent in 1980; while total employment in the iron and steel industry declined from about 572,000 in 1960 to 453,000 in 1979. 11/ Employment dropped to 361,000 in 1981, of which 258,000 were steel workers and 103,000 were salaried employees. By the end of recession-wracked 1982 the total was reduced to 235,000 of which 156,000 were steel workers and 79,000 were salaried employees. 12/

The Commerce Department report on the automobile industry, released in December 1981, concluded that domestic producers are not competitive with Japanese producers.[13/] While this situation has been developing for some time, it has only been acute since 1978. The Commerce Department study reported that unemployment in the auto industry may have reached 300,000 during 1980, with unemployment among auto suppliers and distributors estimated to be as high as 1 million. Employment in auto manufacturing fell from 1.03 million in 1978 to 685,000 in 1982. While recession, high interest rates, and high fuel prices account for much of the decline in new car sales, so that total sales can be expected to recover somewhat from recession levels, the U.S. auto industry has also lost a share of its domestic market to imports as a result of strategic errors in auto company decisions. Having guessed wrong on the shift in consumer demand toward smaller, fuel efficient vehicles, the industry found itself with an inappropriate capital stock and facing a long lead time for conversion from the production of big to small cars. The shift to imports to satisfy the demand for small cars left U.S. car makers with a smaller share of a shrinking market: new car sales were 21 percent lower in 1980 than in 1979, but U.S. cars dropped by 41 percent, though U.S. producers held their share of the domestic subcompact market.[14/] Sales of U.S. cars are improving as the recovery gets underway. However, the increase in the share of the U.S. market accounted for by imports, as well as the introduction of industrial robots and foreign production of component parts of American cars, mean that automobile employment will remain permanently below its 1978 level, and may not rise much above its 1982 low.

Textile and apparel imports in significant quantities began in the 1950s with the entrance of cotton textiles from Asia. The labor intensive nature of many textile and apparel processes gave low wage countries a comparative advantage. Capital investments in this industry were undertaken during the 1960s and 1970s, thus enabling domestic producers to offset this advantage to some extent. Real output more than doubled since 1957 with no increase in hours worked, however. 15/ Nevertheless, the U.S. share in world production has declined since 1969 in a wide variety of apparel products including suits, trousers, dresses, and skirts, slacks, and shorts. 16/

In addition to apparel, crude steel, and passenger cars, the U.S. share in world production has declined in a number of important industries. These include zinc, cement, plastics, synthetic rubber, synthetic fibers, and consumer durables like TV sets and refrigerators. 17/ With the exception of synthetic fibers, Japan's share of world output of these products over the same time period (1969-1978) has increased. 18/ The extent to which these differences can be attributed to strategic differences in investment performance is difficult to ascertain, though this is clearly the case in steel and color TV which have been studied in detail. 19/ In any event, the curtailment of employment growth in the older manufacturing sectors--and actual job loss in some industries--has serious consequences.

One result has been a regional shift in manufacturing employment within the U.S. as jobs in steel, rubber, and autos have declined while jobs in electrical and electronic equipment (primarily semiconductors) and defense-related industries have increased.

Nationwide, employment increased 24.3 percent between 1968 and 1978 (prior to the recessions of 1980 and 1981-1982) from approximately 76 million to 94 million workers. Manufacturing employment, however, grew by less than 700,000 workers, an increase of less than 4 percent. Very slow growth in manufacturing during this period was not the whole story; national figures hide regional differences. Factory employment increased in the South by more than 900,000, in the West by more than 300,000, and in the North Central region west of the Mississippi by 200,000, while declining in the Northeast by almost 800,000 jobs. [20] This is not intended to suggest that the flight of Northern industry to the South has been the major component of Southern economic growth, though some textile, apparel, and electronic component firms did make the move. Regional shifts in manufacturing are due in large measure to the growth of employment in manufacturing industries already located in the South and West. Employment in the electronic components and accessories industry, which includes semiconductors and related devices, increased by nearly 250,000 between 1971 and 1981 and has grown slightly since then despite the recession; with much of the growth occurring in the West. [21] On the other hand, the South had the smallest proportion of its durable goods employment in primary metals, transportation equipment, machinery, and fabricated metals which have experienced secular declines exacerbated by the recent recessions. Back-to-back recessions reduced manufacturing employment by 2.5 million nationwide. Fifteen of the 20 manufacturing industry components experienced employment of 5 percent or more. The largest cutbacks were in nonelectrical machinery, primary metals, fabricated metals, and transportation equipment. Since 1979, these four groups have seen a combined decline of 1.3 million, accounting for over half of the overall manufacturing decline of 2.5 million. [22] Most occurred outside the South.

Defense spending patterns have intensified the shift of manufacturing industry out of the Northeast and North Central regions and into the South and West. The South's share of military prime contract awards increased from 11 to 25 percent of the total while the West's share increased from 16 to 31 percent between 1951 and 1976. [23] The development of aerospace and other high technology industries in California and several Southern states, and the nation's growing dependence on high technology industries for defense needs, has been responsible for the direction of funds to these areas. Funding of the space program in the 1960s and subsequently had a similar effect. Research and development supported by defense and space program funds led to many commercially successful technological advances. Thus, regions that benefited from such funds have become the manufacturing center for products that include computers, calculators, semiconductors, and scientific instruments. [24]

The regional shift in total employment has been even more pronounced than in manufacturing. Population migration to the South and West resulted in the expansion of industries where demand is largely dependent on local population pressures--services, retail trade, construction of housing and other structures required for residential and industrial development, financial institutions, and transportation.

Total employment grew 24.3 percent nationwide between 1968 and 1978, but the increase was much above this in the South (32.6 percent) and West (39.7 percent), and much below this in the Middle Atlantic (8.7 percent), New England (16.4 percent), and East North Central (15.4 percent). [25] Manufacturing employment played a relatively small direct part in the expansion of both the South and the West. Most of the growth was registered in trade, services, financial institutions, transportation, and public utilities, all of which grew as a result of population shifts or because of the residential and commercial requirements attendant upon such shifts. Construction, too, grew in the South and West as a result of rapid urban and suburban development, construction of interstate highways, as well as the need for industrial structures that accompanied growth in manufacturing. 26/

The change in the industrial mix contributed to an above average increase in employment in industries in which significant proportions (often a majority) of workers are female.

Although manufacturing employment grew slowly in the 1970s, three technology-related manufacturing industries registered substantial gains. 27/ Approximately 600,000 new jobs were added between August 1971 and August 1982 in electronic computing equipment, communication equipment, and electronic components and accessories. Women accounted for more than one-fourth of the employees in electronic computing equipment, one-third of those in communication equipment, and one-half of those in electronic components and accessories ten years ago (at which time they held 5 percent of the jobs in steel and 9 percent of those in motor vehicles and equipment). Nearly half the new jobs added went to women, increasing the proportion held by women to 35 percent in electronic computing equipment and to 40 percent in communication equipment, and leaving the proportion in electronic components and accessories unchanged.

The major employment increases, however, were registered in services and retail trade, primarily in business services, health services, and eating and drinking places. McDonald's fast-food network now employs more people than U.S. Steel.[28] More than 6.3 million jobs were added between 1971 and 1981, approximately three-fifths of them going to women. The proportion of women employed in business services increased to more than two-fifths. While the recession reduced total employment between Fall 1981 and Fall 1982 by more than 2 million jobs, the employment of women increased by 100,000.

Important changes, thus, occurred in the structure of employment and output within manufacturing, and between manufacturing on the one hand and services and retail trade on the other. These changes shifted employment toward industries that employ women.

The change in the industrial mix has also resulted in a decline in employment in industries where organized labor is strong, and an increase in employment in industries where it is weak.

The declines in manufacturing in the Northeast and in steel and autos in the Great Lakes region are declines in industries in which union organization is strong. In autos, basic steel, and iron and steel foundries, virtually all nonsupervisory personnel are unionized. This is in contrast to union representation in retail trade and services, particularly in fast food restaurants and health services, which covers only a small proportion of workers. Moreover, the regional shifts in employment have reduced the influence of unions. Among states in the Southeast and the Southwest, Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia are all right-to-work states, in which union representation is far below the national average.[29] In California, union membership is above the national average though the margin is much smaller than it was in 1970; but workers in the rapidly growing semiconductor industry are virtually unorganized. Nationwide, about 27 percent of semiconductor production workers are unionized; however, 96 percent of them work in the Northeast. 30/

The overall effect has been a decline in employment in regions and industries where wages are above the average in manufacturing, and an increase in employment in regions and industries where wages are below that average.

This has had a direct effect on the wage growth of U.S. workers. Employment growth has been in jobs sex-stereotyped as female, without union coverage, and paying low wages. Thus, in September 1982 average hourly earnings in manufacturing were $8.59, while in eating and drinking places they were $4.09, in nursing homes and personal care facilities they were $4.88, in business services they were $7.09, and in electronic components and accessories they were $7.29. In motor vehicles and equipment, meanwhile, they were $11.69 and in primary metal they were $11.55. 31/

The consequences go far beyond these direct effects, however. For workers whose pay is strongly affected by local labor market conditions, location, degree of unionization, and presence or absence of high paying manufacturing industries are all important factors influencing wages. 32/ This is especially true of office workers, including clerical and electronic data processing personnel, and of plant workers, including maintenance and unskilled plant workers. Thus, among workers in the 70 metropolitan areas studied by the Bureau of Labor Statistics unskilled plant workers in Saginaw, Michigan earned 41 percent above the average of the 70 areas, while those in San Antonio, Texas earned 33 percent below that average. Office clerical and data processing workers were highest paid in Detroit, lowest paid in San Antonio; while skilled maintenance workers were highest paid in San Francisco, lowest paid in Greenville, South Carolina. This illustrates three points made in the study of the 70 areas. (1) Higher paying jobs in plants and offices are found predominantly in the North Central region and the West; lower paying jobs are in the South with the exception of clerical work in Atlanta and Washington. (2a) The degree of unionization in a region affects hourly earnings. High paying regions for plant workers all had union coverage of 45 percent or more of those workers. Some had 80 percent or more. Low paying regions for plant workers all had less than 45 percent of these workers covered. (2b) The degree of unionization in an industry affects the wages of all plant and office workers. All but one of the high-paying industries, machinery, are at least three-fourths unionized. Most low paying industries are primarily nonunion. Only two, men's and women's suits and coats, are three-fourths unionized. (3) While the presence or absence of manufacturing employment in a metropolitan area does not affect levels of pay in the area, those areas in which a substantial proportion of manufacturing workers are in high-paying industries are generally high paying areas. Conversely, wages in general are lower in areas where a substantial proportion of manufacturing workers are in low-paying industries. Thus the changes described above will affect the earnings profiles of workers, office workers in particular, who may not be directly involved in the restructuring of employment in manufacturing and in its relative decline.

Two major implications, each with serious ramifications for continued U.S. economic development, can be drawn. First, a process is already underway that is reducing the growth rate in average wages and eroding *the relative wage position of U.S. workers. In recent years, American workers have experienced a slower rate of growth in compensation than workers in other developed countries.*

The second implication is that a section of industrial workers--primarily male, blue collar workers in the older manufacturing centers--are becoming redundant as the U.S. moves toward an employment structure increasingly dominated by poorly paid jobs that are frequently sex stereotyped as female. Blue collar male workers displaced from their jobs by technology or a changing pattern of imports and exports are not likely to find their labor in demand in the expanding service and manufacturing industries of the South and West.

In 1965, U.S. manufacturing workers were earning $2.61 an hour, while those in West Germany earned $1.02, those in the U.K. earned $1.01, and those in Japan earned 45½ cents. American workers were making 5.8 times as much as those in Japan and 2.6 times as much as thier British or German counterparts.[33/] If wages are adjusted for hours worked (rather than hours earned) in West Germany and the U.S. to make them compatible with those reported for Japan and the U.K., the American advantage over Japanese workers in 1965 is even greater. American workers earned 6.1 times as much as those in Japan in 1965. By 1970, the wages of U.S. manufacturing workers were only 3.0 times those of Japanese workers and 2.0 times those of West German workers. By 1977 the wages of American workers were just 1.6 times those of Japanese and 1.1 times those of West German workers. The comparison of manufacturing industry workers' wage per actual working hour (ratio of wages in U.S. to wages in selected countries) is summarized in the following table.

	U.S./Japan	U.S./West Germany	U.S./U.K.
1965	6.1	2.4	2.7
1970	3.9	2.0	2.8
1975	1.8	1.1	1.9
1976	1.8	1.2	2.2
1977	1.6	1.1	2.3

The exchange rate used in these comparisons is an annual average based on IMF, International Financial Statistics

Source: Derived from Economic Planning Agency, Japanese Government, Economic Survey of Japan 1977-1978, Table 4-2-12.

While the Japanese figures cited above indicate that U.S. manufacturing workers enjoyed a slight advantage over German workers through most of the 1970s, data from the U.S. Department of Labor on hourly compensation for such production workers indicates that by the mid-seventies workers in West Germany and three other countries--Sweden, Netherlands, and Belgium--were earning more than manufacturing production workers in the U.S.. 34/

International comparisons of the average annual percent change in hourly compensation tell the same story: Since 1960, hourly compensation of U.S. employees in manufacturing has increased more slowly than in Japan, Canada or any of the eight nations of Western Europe. The following table reports average annual percent change in hourly compensation in manufacturing for the U.S. and ten foreign countries.

Country	1960-1965	1965-1970	1970-1977
United States	3.7	6.0	6.1
Canada	3.9	8.3	7.9
Japan	13.1	15.4	15.8
Belgium	9.0	8.4	12.4
Denmark	9.0	9.2	12.5
France	9.5	8.6	10.9
W. Germany	13.6	9.3	10.4
Italy	11.4	12.2	15.0
Netherlands	9.5	10.5	13.6
Sweden	7.6	6.9	11.6
United Kingdom	6.4	7.7	11.1
Ten Foreign Countries	8.7	9.2	11.6

Source: Arthur Neef, "Unit Labor Costs in the U.S. and 10 Other Nations, 1960-1971," Monthly Labor Review (July 1972), pp. 3-8; Keith Daly and Arthur Neef, "Productivity and Unit Labor Dosts in 11 Industrial Countries, 1977," Monthly Labor Review (November 1978), pp. 11-17.

The effect of slower growth in compensation on the relative standard of living of U.S. workers is difficult to measure, but the Japanese are clearly gaining. In 1969 a Japanese worker worked 57.7 minutes in order to purchase 100 grams of beef compared with 5.7 minutes for an American worker. By 1977, a worker in Tokyo worked 18.5 minutes for the same quantity of beef while a worker in New York worked 5.1 minutes. 35/ As recently as the mid-Seventies, the number of electrical appliances per hundred households was higher in the U.S. than in any other country. But by 1978, ownership of electric refrigerators, electric washing machines and color TV sets in Japan exceeded that in the U.S.. 36/ Infant mortality rates are often cited in comparisons of the overall quality of life in different countries. By this measure, the U.S. has been slipping:

it ranked sixth in 1955, eleventh in 1960, seventeenth in 1970, and eighteenth in 1977 with 14.1 infant deaths per thousand live births. By comparison, Japan ranked second in 1977 with an infant mortality rate of 8.9. [37/]

Not only are American manufacturing workers becoming relatively lower paid, they face a less hospitable employment situation as a result of the decline in the share of manufacturing employment from 27 percent of employment in 1968 to 22 percent in 1978 and 21 percent in the recession year 1982. [38/] While manufacturing suffered substantial employment declines during the recent recession, the shift away from manufacturing employment and toward employment in service industries has been underway throughout the post World War II era. Between 1947 and 1982 the number of service jobs increased from 5 to over 19 million, with most of the increase coming in the last decade.[39/] Much of this recent growth in service industries was in low wage, short hour employment preparing hamburgers and caring for the elderly and infirm. Employment prospects for male industrial workers are discouraging.

This is not the first time in recent U.S. economic history that economic development has displaced a labor force group. While the employment difficulties of blue collar workers in the Great Lakes and Northeast regions of the country are structural, recent history cautions against dismissing these as temporary adjustment problems which the market can be relied upon to resolve. The roots of black poverty can be traced back to a previous round of economic development, to the displacement of agricultural workers by machinery and the subsequent failure of a growing economy to reabsorb significant numbers of those left jobless by changing labor requirements. [40] The issue is not technological unemployment but structural unemployment: The improvements in technology that reduced labor requirements per unit of output in agriculture contributed to overall economic growth and to increases in total employment, while still leaving large numbers of displaced workers and their descendants outside the economic mainstream. The evidence suggests that another round of this process may be underway. Like the black agricultural workers after World War II, displaced manufacturing workers in the industrial belt that arches from St. Louis through the Great Lakes region and into the Northeast find that their labor is redundant. Their wives and daughters may find employment in low-paying jobs in the sunbelt. Prospects for the men, however, are far less certain. In the absence of U.S. industrial policy it is quite possible that the ranks of the chronically unemployed will expand as wider use of programmable automation technologies (eg., robots) and imported components make it likely that a large number of the 2.5 million manufacturing jobs lost since employment in this sector peaked at 21 million in 1979 will never be recovered.

Economists tend to be sanguine about this, relying on the possibilities inherent in technological innovation to provide employment growth.[41] It is possible that they are right. The introduction of a major new technology does not simply create some jobs while destroying others. Often it serves as the basis for economic growth, raising average annual rates of growth in both labor productivity and total output. Moreover, periods of rapid technological advance have not usually been periods of high unemployment; rather they have been periods in which new sources of employment emerged and total employment expanded rapidly. It may happen, therefore, that despite the shifts in distribution of workers by industry and region, real wages will increase along with technologically induced increases in labor productivity, and virtually all of the labor resources released from the production of steel, rubber, autos, and other industrial products will find comparably stable and remunerative employment in the production of new commodities and services.

Alternatively, one could postulate a darker view of economic affairs in which technology advances but the structural employment problems persist. The savings necessary to finance the expansion of technologically innovative industries (or processes in older industries) could come not from an increase in the percentage of GNP that is voluntarily saved but from slower growth in compensation of production workers and, hence, in the ratio of consumption to output. Moreover, a significant proportion of male, blue collar workers (and perhaps their sons as well), displaced from the smokestack industries, could remain outside the economic mainstream for years, finding intermittent work in low paying jobs, despite the overall increase in employment. One might even speculate that racism will once again intrude so that the group most adversely affected will be black males who comprise one-seventh of the work force in motor vehicles and primary metals industries. [42/]

It would be presumptuous of me to attempt a definitive answer to the question of what the future holds. The enormity of such an exercise can be grasped by imagining an attempt to predict the dynamic economic implications of the telephone in 1886, ten years after its invention, or of the automobile in 1915. Here I shall attempt a more modest task: an examination of the available evidence in order to discern the relationship between "high tech" and employment over the next ten years.

III

High technologies are popularly identified with the technologies of information processing, communications, semiconductors, robots, and biotechnology. A more precise definition can be obtained by reserving the "high tech" designation for those industries in which R&D expenditures as a percentage of total investment and/or the level of scientists, engineers, and technical employees is at least twice the average for all U.S. industries. This definition encompasses 32 manufacturing industries--including computers, communication equipment, electronic components, laboratory instruments, aircraft, space vehicles, drugs, industrial chemicals, and plastics--as well as such service industries as computer programming, data processing, and research laboratories. 43/

Surprisingly, in view of the general perception that high technology has been a major source of employment growth, high tech manufacturing industries did not fare better than other manufacturing industries in providing new jobs for U.S. workers in the last decade. Between the cyclical peak years 1969 and 1979 employment in industries with above average R&D expenditures grew 4.5 percent while employment in industries with high levels of scientific, engineering, and technical personnel grew 2.0 percent. 44/ These growth rates do not differ much from employment growth in all manufacturing, which measured 4.2 percent over the decade; and compare unfavorable with the growth of total employment which increased 27.6 percent. It should be noted that a subset of the high tech manufacturing industries with both high R&D expenditures and high levels of scientific, engineering and technical workers did experience a 26.3 percent growth rate. However, these industries together added only 444,000 new jobs, 2 percent of the 19 million jobs created during the 1969-1979 decade. [45]

High tech service sector industries exhibit a rapid rate of employment growth, but the small size of the sector limits the total number of jobs created. Thus, the computer and data processing services industry, largest of the high tech service industries, added only about 300,000 jobs since 1969. [46] The growth of clerical employment in this industry is slowing as technological advances such as on-line processing and optical character recognition spread.

Looking to the future, Data Resources Inc. estimates that the number of new high tech jobs created between 1983 and 1993 will be 730,000 to 1 million, less than half the jobs lost in manufacturing in the last three years. [47] Rapidly rising productivity as the high tech companies automate, often using their own products to do so, combined with the small size of the high tech sector (about million manufacturing jobs and half a million service jobs in 1979), constrains the ability of this sector to provide employment. Moreover, assembly jobs in high tech industries are subject to competition from low wage labor, particularly in Third World countries like Malaysia, Taiwan, the Phillipines, and Mexico where assembly workers earn al little as 50 cents an hour. Thus, Atari decided in February to move 1700 assembly jobs from California to Asia, Apple Computer and Wang Laboratories have turned to the Far East for substantial preliminary assembly work on computer components, Hewlett-Packard predicts that its overseas work force will grow faster than its U.S. workforce when major plants in Mexico and elsewhere are completed. These jobs follow others implanting metal pins into computer chips for high tech companies such as Intel and National Semiconductor which moved to Asia long ago.

Furthermore, the number of additional jobs in high tech manufacturing industries will, in part, be offset by the number of jobs lost to robots and other programmable automation technologies in traditional industries such as steel and autos. The W.E. Upjohn Institute for Employment Research estimates that the number of robots working in the auto industry will increase from 2,400 to between 15,000 and 25,000 by the end of the decade. It is expected that 3,000 to 5,000 jobs will be created producing and maintaining the robots, while the robots will replace 30,000 to 50,000 auto workers. [48/]

While employment growth in high tech user industries in the manufacturing sector is, thus, expected to be negatively affected by automation, the impact on employment growth in high tech user industries in the service sector is uncertain. European observors expect the cumulative effects of information processing technologies and office automation techniques to substantially reduce the growth of employment in the office industries--insurance and finance. Comparable studies for the U.S. do not exist. There is some evidence from aggregate data on the insurance industry that the introduction of technology between 1960 and 1978 altered the distribution of occupations within the industry but has not slowed the rate of employment growth. To a large extent this was due to the introduction of new services. In part, it was due to the fact that productivity growth took the form of better performance and higher quality services rather than a reduction in labor requirements. Wide spread use of office automation technologies has slowed the growth of clerical employment substantially, but the implications for overall employment growth are difficult to evaluate.

The analysis of the previous section focused on aggregate employment possibilities. To discuss the qualitative aspects of the new jobs being created--within the high tech sector and downstream, within traditional industries that utilize high tech products and services--requires that we turn our attention to how labor markets are structured.

It is evident that the U.S. labor market is segmented into a primary labor market segment in which most of the "good" or "acceptable" jobs are located, and a secondary labor market segment in which most of the "poor" jobs are to be found. A further distinction can be made between autonomous primary segment jobs (professionals, like doctors, lawyers, and professors, or craftsmen like plumbers, electricians, carpenters) and subordinate primary segment jobs (mail carriers, insurance adjustors, steel workers, etc.). The difference between a subordinate primary segment job and a secondary segment job is sometimes based on worker skills and sometimes on non-skill related job characteristics. The better jobs are those in which the employer values steadiness and low turnover and is willing to reward tenure on the job with promotions and higher pay, or in which the employee is represented by a union that has won decent wages, a pay scale that rewards seniority, and protection against arbitrary treatment. Many of the subordinate primary segment jobs available for male workers are to be found in the goods producing sector of the economy, where workers have more union representation than in other sectors of the economy.

The growth of the high tech sector has provided both good jobs and

and poor ones. Producer services (advertising, architecture, law, management consulting, computer and data processing, financial) now account for 19 percent of GNP, and high tech firms in this industry have been a major source of good jobs. This observation is confirmed by the Bureau of Labor Statistics (BLS) study of the computer and data processing services industry. The computer and data processing services industry (SIC 7372 and SIC 7374) provides employment primarily for professional/technical workers and office clerical workers. 49/ Professional workers are engaged in work at a level which requires knowledge equivalent to that acquired through completion of a four year college course, regardless of whether they hold a degree. Technical workers are engaged in technical work utilizing theoretical knowledge acquired through formal post high school training or through equivalent on the job training. Approximately 37 percent of employees in this industry are professional or technical workers. Of these, one-fifth are computer systems analysts, one-fifth are computer operators, and one-eighth are computer programmers. The remainder are employed as computer data librarians, electronics technicians, and peripheral equipment operators. Most of these employees are male, with the majority of women analysts, programmers, and operators in the lowest classification in each of these occupations. Average salaries for computer systems analysts ranged from $400 to $460 a week in March 1978 in most regions ($515 in Newark). Computer programmers averaged $262 to $326, and operators earned $181 to $233. Electronic technicians accounted for less than one percent of the workers and earned $250 to $300. Office clerical employees account for 32 percent of employment. With the exception of some of the accounting clerks and messengers, they are virtually all women. Two-fifths of them are key entry operators earning $150 to $205 (Class A) or $135 to $175 (Class B). Personal secretaries are not very numerous, but they are highly paid in comparison with other clerical workers. In the highest category they earn between $195 and $230.

The study of wages in this industry illustrates the point that high tech employment, like employment in the U.S. generally, is two-tiered. The growth of high tech service sector employment has meant an increase in professional, technical, and managerial jobs at the top; but it has also meant an increase in clerical, sales, and nonprofessional service jobs at the bottom.

It's not news that most jobs in high tech manufacturing industries are not high tech jobs, but it may be surprising to learn that many are not even very good jobs. BLS surveyed the semiconductor industry, which currently employs 235,000 workers. Of the workers employed in this industry, approximately 58 percent are production (plant) workers and 14 percent are office (nonplant) workers. The remaining 28 percent are administrative, executive, professional and technical employees who are "used as a separate work force on the firm's own properties." Six production occupations are included in the study: assemblers (Class A, B, or C); crystal processors (crystal coaters, cutters, finishers, growers); inspectors and testers (Class A,B,or C); maintenance (electricians, machinists, general, pipefitters); janitors, porters, and cleaners; laborers, material handling. More than 60 percent of the plant workers are in the first three occupations, most of them women. Two office occupations were included in the survey, computer operators and engineering technicians Classes I through V, most of whom are male. These account for 40 percent of the office employees; the others are employed as general office clerks and secretaries. Percent female and average hourly earnings for each occupation studied are summarized below. (Data are for 1977, when the study was done.)

Occupation	Percent Female	Average Hourly Earnings	Occupational Distribution (percent)
Assemblers	92.0	$4.08	45.1
Crystal processors	73.2	4.18	2.5
Inspector and testers	88.1	4.84	7.0
Maintenance	0.0	6.50 - 8.48	2.0
Janitors, porters, and cleaners	13.6	4.34	0.9
Laborers, material handling	18.7	4.14	0.5
Computer operators	49.6	5.97	0.4
Engineering technicians	12.3	6.80	6.8
Class V	0.0	8.41	2.4

Average hourly earnings of plant workers ranged from $3.38 for crystal coaters (90 percent female) to $7.94 for maintenance pipefitters (100 percent male).

A wage below $6.00 an hour placed a U.S. worker in the bottom third of the income distribution in 1977, while a wage above $9.50 placed that person in the top third. On that criterion, 28 percent of the jobs in this industry were good jobs at the top of the distribution, 9.2 percent were in the middle, while 62.8 percent were low paying jobs. Low wage production jobs in Silicon Valley are poor in other respects as well--they are tedious and they expose workers to dangerous occupational health hazards.

If these two industries, one in goods production and one in services. prove to be at all representative, then it seems evident that the new high tech industries will not provide alternative employment opportunities for male blue collar workers displaced from the older industries. Apart from the limited number of aggregate jobs produced by the high tech sector, skill requirements in industries in this sector do not correspond to the skills of the displaced workers. Thus, most of the jobs held by male workers in the computer and data processing services industry require two to four years of technical training. In semiconductors it .is the fact that male plant workers (skilled and unskilled) make up less than 5 percent of the work force that creates a problem. Moreover, male workers with middle level skills are not represented in this industry at all.

What is striking about the motor vehicles and parts, basic iron and steel, and iron and steel foundries industries is the large number of occupations in every skill category among plant jobs. The significance of having a wide variety of jobs available is the wide variety of skills and skill levels that can be accomodated in employment in these industries. In addition, most of the plant occupations do not require formal schooling beyond high school, and the skilled trades can often be learned through apprenticeship or other training programs. This contrasts markedly with the two high tech industries for which data on occupations and wages are available.

The available evidence suggests that the high tech sector will not provide solutions for the structural employment problems that are emerging in the 1980s. Expanding employment opportunities in high tech manufacturing and service industries tend to be in jobs that are sex stereotyped as female. Middle level opportunities for men are not abundant.

Changes in technology combined with the shift to service sector employment are eroding the middle of the job distribution, making the labor market more starkly two-tiered with good jobs at the top, poor jobs at the bottom, and shrinking opportunity in the middle. The best jobs and the poorest jobs are both expanding in number. It is the young people who have succeeded in secondary school, and who enter the world of work motivated to do well and prepared to work hard, who will find it difficult to find worthwhile jobs in this emerging work environment. Well paid, stable employment in basic manufacturing industry for men and traditional clerical employment for women filled the middle of the occupational distributions for male and female high school graduates, respectively. The contraction of the middle of the opportunity structure is a treacherous problem whose dimensions will become clear by the end of this decade.

Public and private programs to upgrade training and education and to provide for retraining are an essential and welcome means of reducing the severity of this problem. There is evidence to suggest that an active labor market policy--providing job search,employment counseling and relocation services and establishing retraining programs for workers displaced from jobs in the primary labor market segment--can be effective in reducing structural unemployment. Adult unemployment rates in the U.S. have been much higher than in other OECD countries (except Great Britain). Yet restructuring in the industrial composition of the labor force was as least as extensive in Europe and Japan as in the U.S. during the 1970s. But such programs are inadequate, by themselves, to eliminate the emerging structural employment problems. To solve the structural problems, programs to improve the education and training of workers will have to be linked to programs to transform the characteristics of poor jobs. The sex-stereotyping of jobs, which is deeply embedded in both labor market structures and popular culture, increases the difficulty of adjustment to the changing industrial base and will have to be overcome. The intense application of anti-discrimination policies will be required. Faith in the job creating potential of high tech to solve the emerging employment problems--higher rates of unemployment and job growth in low wage employment--is, we have tried to demonstrate, unwarranted. Serious attention will have to be given to the development of active labor market policies during the 1980s.

FOOTNOTES

1. The Department of Commerce reports that fixed investment increased from 9.5 percent of GNP in 1950 and 1960 to 10.5 percent in 1970 and 11.3 percent in 1980.

2. U.S. Congress, Joint Committee on Taxation, Analysis of Proposals for Depreciation and Investment Tax Credit Revisions, Part I (Washington, D. C., May 1981), p. 17.

3. Ernst R. Berndt, "Energy Price Increases and the Productivity Slowdown in United States Manufacturing," The Decline in Productivity Growth (Boston: Federal Reserve Bank of Boston, June 1980), pp. 60-89.

4. Lester Thurow, "Death by a Thousand Cuts," The New York Review of Books (December 17, 1981), pp. 3-4.

5. MITI, Business Analysis of World Enterprises, cited in Economic Planning Agency, Japanese Government, Economic Survey of Japan, 1979-1980, Table II-1-7, p. 133.

6. Robert W. Crandall, "The Economics of the Current Steel Crisis in OECD Member Countries," Steel in the 80s (Paris: Organization for Economic Co-operation and Development, 1980).

7. Ira C. Magaziner and Robert B. Reich, Minding America's Business (New York: Vintage Books, 1983), p. 166.

8. Ibid., p. 159.

9. Ibid., p. 161.

10. Testimony before the House Committee on Energy and Commerce, Capital Formation and Industrial Policy (Washington, D. C., July 1981), p. 302.

11. American Iron and Steel Institute, Annual Statistical Report, Table 1A (1970 and 1978); and American Metal Market, 1981 Metal Statistics, p. 169 and p. 171.

12. The New York Times, March 3, 1983.

13. The New York Times, December 2, 1981.

14. Ibid. Employment data from Employment and Earnings, Annual Supplement, 1982.

15. Rivlin, Testimony before the House Committee on Energy and Commerce, p. 302.

16. United Nations, Yearbook of Industrial Statistics, 1978.

17. Ibid.

18. Japanese Government, Economic Survey of Japan 1969-1970, Table 74 and Economic Survey of Japan 1979-1980, Table II-1-6.

19. Magaziner and Reich, Chapters 13 and 14.

20. Philip L. Rones, "Moving to the Sun: Regional Job Growth, 1968 to 1978," Monthly Labor Review (March 1980), pp. 12-19.

21. Employment and Earnings (November 1971, November 1981, and November 1982), Table B-2.

22. U.S. Department of Labor, Bureau of Labor Statistics, Middle Atlantic Region, News Release, December8, 1982.

23. Rones, pp. 12-19.

24. Ibid.

25. Ibid.

26. Ibid.

27. Except where noted, all data in this section are from Employment and Earnings (November 1971, November 1981, and November 1982), Tables B-2 and B-3.

28. Cited by W. Paul Tippett Jr., Chief Executive Officer of the American Motors Corporation, in The New York Times, March 10, 1983.

29. Department of Labor, Bureau of Labor Statistics, Handbook of Labor Statistics, Bulletin 2070 (December 1980), Table 166.

30. Department of Labor, Bureau of Labor Statistics, Industry Wage Surveys: Semiconductors, Bulletin 2020 (September 1977), p. 5.

31. Employment and Earnings (November 1982), Table C-2.

32. U.S. Department of Labor, Bureau of Labor Statistics, Profiles of Occupational Pay, Bulletin 2037 (1979) is the source of data in this paragraph. Data are for 1976.

33. Economic Survey of Japan 1969-1970, Table 76.

34. Cited in Magaziner and Reich, p. 37.

35. Economic Survey of Japan 1969-1970, Table 77 and Economic Survey of Japan 1977-1978, Table 4-2-12.

36. Economic Survey of Japan 1979-1980, Table II-1-2, and Economic Survey of Japan 1976-1977, Chart II-2-6.

37. U.N. Demographic Yearbook, 1978, pp. 286-289.

38. Employment and Earnings (various years), Table B-2.

39. U.S. Department of Labor, Bureau of Labor Statistics, Middle Atlantic Region, News Release, dated December 8, 1982.

40. See Jay R. Mandle, The Roots of Black Poverty (Durham, N.C.: Duke University Press, 1978).

41. A less compelling argument advanced by economists is that exchange rate adjustments will be able to resolve the problems described above in the text. The objection can be summarized as follows: To the extent that a pessimistic outlook hinges on a loss of comparative advantage in durable goods manufacturing, freely floating exchange rates and the resulting appropriate depreciation of the dollar will restore the trade balance by making some American goods sufficiently cheap abroad that other countries' imports of them will increase. This is not a fruitful line of reasoning. First, this scenario depends on the highly questionable assumption that the monetary authorities will allow a sharp devaluation of the dollar, an assumption not supported by past experience. Moreover, it would require an about face on domestic monetary policy since the high U.S. interest rates support the value of the dollar in international exchange. Still another consideration is the effect that a sharp devaluation of the dollar would have on oil prices and/or oil exports in view of the fact that OPEC oil exports are denominated in dollars. Dollar devaluation would reduce the price of OPEC oil in the rest of the world while leaving it unchanged in the U.S., thus reducing the relative cost of producing output in energy intensive industries outside the United States and worsening the competitive position of American industries in world markets. Of course, a sharply lower real price for oil in terms of international purchasing power is likely to lead the OPEC countries to attempt to increase the dollar price of oil. If successful, this would jolt the U.S. economy with yet another energy shock. Finally, a dollar devaluation, even if it increases total U.S. exports, will not resolve problems caused by the United States' loss of competitive advantage in a number of key industries. Magaziner and Reich discuss this point at length in Chapters 5 through 16 of Minding America's Business.

42. U.S. Department of Labor, Bureau of Labor Statistics, Annual Earnings and Employment Patterns of Private Nonagricultural Employees, 1973-1975, Bulletin 2031 (1979).

43. The 36 industries that fit this definition of high tech, identified by SIC code, are: 2831, 2833, 2834, 3572,3573,3574, 3576, 3579, 3661, 3662, 3671, 3672, 3673, 3674, 3675, 3676, 3677, 3678, 3679, 3721, 3724, 3728, 3761, 3764, 3769, 3811, 3822, 3823, 3824, 3825, 3829, 3832, 7372, 7374, 7379, 7391.

44. Donald Tomaskovic-Devey and S. M. Miller, "Can High-Tech Provide The Jobs," *Challenge* (May/June 1983), p. 60.

45. *Ibid*.

46. *Employment and Earnings* (March, various years), Table B-2.

47. "America Rushes to High Tech for Growth," *Business Week* (March 28, 1983), p. 85.

48. *Ibid*., pp. 86-87.

49. Administrative, executive, and supervisory personnel (including working supervisors) are excluded from the survey. All data are from the Department of Labor, Bureau of Labor Statistics, *Industry Wage Survey: Computers and Data Processing Services*, Bulletin 2028 (March 1978).

50. Current employment is given in *Employment and Earnings* November 1982 Table B-2. All other data are from U.S. Department of Labor, Bureau of Labor Statistics, *Industry Wage Survey: Semiconductors*, Bulletin 2020 (September 1977).

Mr. **Walgren**. Thank you very much.

Let me, in the interest of time, turn to the other members. Inasmuch as Mr. MacKay and I have both interrupted, the Chair recognizes Mr. Brown.

Mr. **Brown**. Mr. Yankelovich, you made a reference which intrigued me, indicating evidence that there was a substantial rise in entrepreneurship and an interest in entrepreneurship. I wonder if you could either elaborate on that or cite the basis for that interesting bit of information and indicate something about its significance.

Mr. **Yankelovich**. Yes. The statistical basis was mentioned—part of it was mentioned—by David Birch in his testimony. I have the numbers here, if I can lay my hands on them momentarily.

He cites the numbers of new incorporations from his testimony at the level of 90,000 in 1950, 200,000 in 1960, 300,000 in 1975, 600,000 in 1981, which excludes partnerships and self-employed.

What you find are two sets of data. This is the data that is the official data. The data we see on the people side is; an enhanced interest in running your own business; in owning your own operation; in being part of a small enterprise; in having entrepreneurship within a larger entity; within corporations an effort being made to give people some stake, some kind of entrepreneurial stake. The entrepreneurship varies all the way from semiartificial modes of entrepreneurship within a highly structured corporation to individuals going out and starting their own businesses. I would anticipate that in the future we are going to see this rather explosive trend explode even further. It will go on. It is one of the most vigorous trends and most heartening trends in the country.

Mr. **Brown**. Do you see that as relating to your statistics also, which seem to indicate a trend toward an improvement in the quality of the work situation? It seems to me that there is a quality about entrepreneurship that obviously attracts people. They find it a more satisfying kind of a life. However, you indicated that there was a trend toward that sort of thing, as indicated by the desire of people to continue to work after they reach retirement age and improvement in the work ethic. You related that to the improvement in productivity, the quality of work.

What I am trying to envision here is, if we may be on the verge of an era in which we might want to set as a policy—and I do not mean by that to write it into law or anything, but acknowledge as a goal that would enhance our own global competitive position—the specific matter of improving the nature of the work situation; that is, make work something that involves people and motivates them in a more realistic way than it does.

Mr. **Yankelovich**. I think very much so. It gets very specific as to what Dr. Appelbaum underscored. I would like to reinforce the point she made about management strategies.

If companies have the choice between using their technology in the way that she described, to enhance the job, to enhance the autonomy and discretion of the person or to diminish it—that they have that choice—then in a sense the question in my mind I would like to throw back at you and the other members is: Is there anything the Government can do to help nudge that choice toward the first rather than toward the second alternative?

The general management philosophy in the United States has tended to be to nudge it toward the second. In the effort to increase efficiency, in order to increase productivity, the first impulse of most industrialists is to cut down their labor cost, to eliminate labor, and to simplify. The heritage of Taylorism is still very deeply ingrained in management philosophies, even though it may be completely inappropriate in today's economy.

If there is any kind of leadership that the Government can—either through goal-setting or through reinforcing that as a norm—if there is any kind of leadership the Government can provide, I think it would make an enormous difference both on the economic competitive side and on the human quality-of-life side. It is not often you have the opportunity to strike a blow for both simultaneously, and this is a major one. I would emphasize that and thank Dr. Appelbaum for that very concrete illustration of how it can be implemented.

Mr. **Brown**. I think we are on to something significant here, but there are going to be obstacles in the sense that if you propound the goal of improving the quality of work life, you are going to be accused of sacrificing the bottom line. You develop the image that you are interested, you might say, in a permissive work environment, lack of discipline, lack of commitment.

I would like to see if there really is an incompatibility. I would like to be able to assert that improving the quality of work life also improves the quality of productivity and the ultimate profitability of the enterprise.

Do we have anything bearing on that which we could present to some of the hardnosed critics?

Mr. **Yankelovich**. I think we do. I think that the history of the quality-of-work-life movement is somewhat unfortunate in the sense that, rooted in the values of the sixties, it emphasized employee desires at the expense of productivity, and employee desires are infinite. If you cater to those, the productivity could go down the drain.

In 1975, Professor Katzel of NYU and I did a project for the National Science Foundation, summarizing all the data on job satisfaction. One of the things that we found is that there is no real relationship between job satisfaction and productivity, because you could be satisfied because you do not have to work very hard and you could be dissatisfied because people were putting obstacles in the way of your doing a good job.

Since that time, we have been aware of the difference and have developed a distinction between things that people want that satisfy them—the quality of life—but do not affect productivity and things that add to performance. That is a very useful distinction because dental care and convenience of location and values of that sort people want and they value, and they add to their job satisfaction, but they do not really contribute to people's performance, and they say so.

On the other hand, enhancing skills—doing precisely the kinds of things where you make the master machinist job more meaningful rather than reducing it—makes a direct contribution to the bottom line.

We have some of that data. There is a Work in America Institute which has been developing a lot of research to try to show where quality of work life and productivity are compatible and where they are not compatible.

I would say that if you could get companies to overcome their prejudice against the history of that movement and simply look at the present situation, we could find—we have a lot of evidence to show how you can enhance people's commitment in ways that directly impact the bottom line. In other words, they are not automatically reconcilable; but with knowledge and factual analysis, you can find precisely ways of reconciling them.

Mr. **Brown**. Thank you very much. I appreciate that.

Mr. **Walgren**. Mr. Dymally.

Mr. **Dymally**. Thank you, Mr. Chairman.

To both panelists, I believe you suggested that one of the ways we have to explore for new jobs is in the public sector. Is that correct?

Mr. **Yankelovich**. I do not think that necessarily follows, that the jobs would have to be created in the public sector. They may or may not be, but I think that is almost a separate question.

Dr. **Appelbaum**. I do not know what you mean by public sector exactly. For example, if there is a construction worker building a highway, do you consider him a public sector employee or not? Probably not, because you have contracted for that service through a private employer.

Mr. **Dymally**. Let's say not.

Dr. **Appelbaum**. It is not a question of whether it is public sector or not, but I think what you are saying is that there are going to be serious problems of unemployment that the private sector by itself cannot meet. That is definitely a true statement.

I have a point of view on this. I think that the problem with public service employment, as we have looked at in the past, has been that it has been viewed as make-work. It is just like the issue of quality-of-work life. If you focus on quality-of-work life and not on productivity gains, it is a very difficult issue to deal with. If you say, what can we do that will maximize long-run productivity gains as opposed to short run, frequently—not always, but frequently—this leads to improved jobs.

It is the same thing with public service employment. If you are looking at this, if you say here is this poor person and he has no skills, what can we do with him, you are never going to get anywhere. However, if you say to yourself, this is a society with unmet needs, what are the important ones the communities would like to provide for themselves, that is another story.

The idea that some people have is that somehow if you have this kind of employment meeting needs collectively—whether it is through the public sector or subcontracted to the private sector is immaterial as far as I am concerned—if what you are trying to do is to meet collective needs, things that people can recognize, the things that they want done, this improves economic efficiency.

There is some sort of myth that says that only if it is a private need being met privately, unless it is construction or defense, it is somehow reducing economic efficiency. Economy efficiency means that we are using our productive resources fully. We are on what economists call the "production possibility frontier."

Whenever you see unemployed resources and unemployed workers, you know that you are inside the production possibility frontier, and you can make everybody better off by moving in a northeast direction toward the frontier.

It is easy to think of things. Just think of things that rich people manage to provide themselves with—day care for their elderly parents, day care for their young children, theaters to go to. Who could afford it today at $20 a ticket—$40 for a couple—to go to the theater? It is impossible.

Mr. **Dymally**. It is a little higher in Los Angeles.

Does that not run counter to Reaganomics? Have we not seen a decline in that approach for the past 2 years and an increase in unemployment?

Dr. **Appelbaum**. That is right.

Mr. **Dymally**. That is why I said you could never work for the White House in the next 18 months.

Dr. **Appelbaum**. That must be a true statement.

Mr. **Yankelovich**. I think my sense of the administration's position is that it is correctly focused on the fact that regions and sectors are going to have to take more initiative and more autonomy, but what it has, in my view, failed to do is to provide the programs to make that possible because of an ideological resistance to such programs. To me, it is a subtle and nonpartisan matter, but I would certainly agree with Dr. Appelbaum that in the future if technology helps to create wealth and makes us more competitive, by itself that wealth is not going to result in the automatic absorption of the people who need jobs unless a special effort is made to make it happen. That special effort, it seems to me, has to be led by Government. Otherwise, it either will not happen at all, or it will happen in a way, as she points out, where in the 1950's there are still displaced agricultural workers and their children suffering in the central cities, or it will take such a long transition—10, 15, 20 years—that millions of people will suffer.

It seems to me that it is a necessary focus of public policy.

Mr. DYMALLY. Mr. Chairman, I have one quick question for Mr. Yankelovich.

You described some surveys you did with jobholders. Have you done anything with the unemployed to get a feel of how they feel about themselves, America, and the workplace, et cetera?

Mr. YANKELOVICH. I have looked at a lot of data that has been done with the unemployed. Of course, one study after another documents the fact that unemployment is a hazard to your mental and physical health. It leads to almost every conceivable ailment in the book, including depression, suicide, alcoholism, drug abuse, nervousness, debilitation, divorce, and every form of social pathology imaginable.

You cannot have a policy of full employment in a society that puts identity and the person's very essence associated with jobs and then take jobs away from tens of millions of people. You just cannot do it.

Mr. DYMALLY. Thank you, Mr. Chairman.

Mr. WALGREN. Let me just, if I might, follow up on that.

I wonder if there is a way to get the Surgeon General to make that statement.

Mr. YANKELOVICH. The data base for doing so is very ample. If the Surgeon General were to authorize a disinterested group of scientific researchers to review the data and issue a report, it might have the credibility of that official imprimatur pulling together the diverse body of good documentation on those psychosocial effects of unemployment. It would be a good idea.

Mr. WALGREN. Maybe he needs a specific request, and we ought to think about giving him one.

Mr. MacKay.

Mr. MACKAY. Mr. Yankelovich, it seems to me that you did a beautiful job in your first sentence or two in summarizing or focusing what this hearing is all about. It helped me, anyway, very much.

You said that our job is to try to reconcile the two views: One, that more is better; and the other, that more is very threatening.

I am looking now for kinds of policies that would do that. I do not think anybody disagrees that it is going to happen. It is no longer a function of what Government policy or private industry in this country does. It was that way for 30 years, but now we are players on a field and the driving forces are coming from a number of places.

It would seem to me that a policy that would cushion our workers, as you suggested, is an excellent way to go. It would seem to me that Government could, perhaps by the way we handled the funding for the retraining—if I were going to define it, it looks to me like the growth industry of the eighties is going to be retraining existing workers.

Mr. **Yankelovich**. That is right.

Mr. **MacKay**. If we fund that in one way, then we are going to have to go back to the systems that now do not have the linkage, as Dr. Brinner suggested, the systems that are being driven by whatever the curriculum was that educated the teachers, which as I understand it was agriculture and home economics. That seems to be what we tend to teach.

Maybe by having the employer have to contribute to a fund and that it be deductible, which means you have a partnership between Government and the employee having an incentive to do that, then you could have the retraining industry driven by the needs of the consumer.

Do you see that as a possibility that would keep us out of the business of Government trying to plan? It would, in essence, take some of the ideas you have given—freedom and flexibility to the employee. You would say to him, "Here are the funds. You figure it out."

Mr. **Yankelovich**. I think very much so. If you take a situation of the United States with, let's say, zero job security and Japan and the big corporations of lifetime job security, truth probably lies somewhere in the middle.

If we move toward enhancing job security in the conventional sense, we may take away some of the flexibility of the economy. You see that in Germany where productivity has gone up and employment has gone down, because of their restrictive kinds of job security legislation where if you are a small business and you hire somebody when you need them, you are stuck with them when you do not need them. Therefore, what the Germans do is they do not hire them.

You have that kind of alternative way, it seems to me. It is implicit in the questions you have asked from the beginning of this afternoon. You can put either in the hands of the employer or the individual some working capital, some resource, that they can use for training.

One idea that occurred to me might be to follow the same pattern as the pension. If you work for somebody for 5 years, there is a contributing fund—maybe you contribute and the employer contributes—and it vests at a certain point. It is like a pension, a combination of pension and insurance. The people who go on and never change their jobs are, in effect, helping to subsidize——

Mr. **MacKay**. Really, when you think about it, it is an insurable event. There is going to be a turnover of 12 to 15 percent maybe, or you could say what it is, and that turnover is going to go up; and we do not know who it is going to happen to, but we do know it is going to happen to so many people.

Mr. **Yankelovich**. That is right. If you conceived of a way, a fundable mechanism of portable employability, that could be earmarked, either in a completely flexible way as a sum of money or maybe earmarked either for training or relocation, or job creation within the community—if that were administered not on a national basis, but by individual companies and regionally, because in the regions and in the particular areas they know where their needs are, you could use that as a potential source of funding for regional development and cushioning the effects. In some places, it would go primarily to retraining. In other places, it would go to relocation. There are places, I think most interestingly, those moneys might go to job creation to tend not only the social needs of a community, but the infrastructure needs that directly impact the economy, that help transport coal, that help the school system, or some other kinds of job-creation programs within communities.

Dr. APPELBAUM. May I ask a question related to that?

I like that idea. I had not thought of it before I heard you speak of it. I am just concerned if we look at what is happening to the middle of the occupational distribution. Suppose that the fund existed today. Mr. Yankelovich said something about job creation. Maybe that takes care of it. I am not sure. Suppose you had that situation.

When I look at the Philadelphia school situation, where we have 600 kids in programs leading to jobs, and there is no question of the success of this. These kids learn to read. They have 100 percent attendance. Everything you want to have in an educational program is happening. However, business is only willing to fund 600 positions like this.

We have one in office automation. We have one in electrical, in different industries. Still, only 600 kids total can we handle this way.

What I wonder about is this: Even if you had those funds, for what exactly would the people who are today in the middle of the occupational distribution be retrained? Some of them could be retrained for better jobs. Those jobs are expanding. That is why the whole issue of education is such an important issue. There are good jobs at the top that are growing.

However, it is not the case that if we turn out all young people well educated with computer skills that we would have less unemployment. We would just have educated people who are unemployed.

Mr. MACKAY. That, in fact, has been the comment of one of the witnesses at this hearing. We need to be very cautious with all of the high hopes about better math and science education because, in fact, the jobs are not going to be there for high school graduates better educated in math and science, and you are going to create a pool of better educated, frustrated people.

Dr. APPELBAUM. That is right. If you are thinking in terms of——

Mr. MACKAY. It is desirable that they be better educated, but not with the guarantee that there is a job there necessarily.

Dr. APPELBAUM. If you are thinking in terms of job creation, it is another issue. I agree with the infrastructure——

Mr. YANKELOVICH. I think you have to think in terms of job creation. I do not think there is any way out of the puzzle unless you think in terms of job creation.

Dr. APPELBAUM. Those jobs can be good jobs. When you look at a school teacher, you do not say, "funded by the public sector."

Mr. MACKAY. Now that is the other question. I would like to come back to that, because that question was posed by Dr. Brinner's comment that, unfortunately, our economy was unable to deal with the fact that we were less wealthy, except by squeezing down and creating huge unemployment; whereas, the Japanese economy had a great deal more flexibility.

I took the implication of that to mean: Because they had job security, they had more flexibility, and they were able in their pattern of bargaining to bargain wages down so that you did not have high unemployment.

Is that an implication in America and Britain? I am not saying unions are bad. I am saying the historic pattern is such that you bargain, as you suggested, Mr. Chairman. Whatever happens, our membership, whoever they are, are going to benefit. Therefore, the implication is: We will bargain contraction in a way that there are fewer jobs, but nobody's wages go down.

Mr. **YANKELOVICH**. I think that Chairman Walgren's comment was very apropos. While he was making it, I was thinking of Britain. That is exactly what happened in Britain. The conservatives and the labor movement conspired to increase the unemployment of those who were not members. You get unprecedented levels of unemployment precisely along the pattern that——

Mr. **MACKAY**. One way out of this, besides Government creating jobs, is to divide the existing jobs in ways that they go further.

Mr. **YANKELOVICH**. Yes. In all the union testimony before this committee, that has been a theme—early retirement, reduce the 40-hour week, job sharing of some sort.

We see that happening in Europe. It is kind of an admission of defeat before the fact. We may be driven to that. I think that the British are driven to it, because they do not have our resources and they have given up on growth. I do not think we have to give up on growth.

You have a spirit and a zeal and an opportunity. We do not have to say that our present lack of competitiveness is permanent. Why not focus on the causes of that lack of competitiveness? From the point of view of our studies, there is no mystery to the lack of productivity growth. The economists just have not been looking at the right variables. The human factor can account for it several times over.

We do not have terms such as—what was it, a wonderful term—"disembodied"?

Dr. **APPELBAUM**. Technological change.

Mr. **YANKELOVICH**. Technological change, which, if I understood it, meant you put some emphasis on people. That is not disembodied at all.

Dr. **APPELBAUM**. I know. I will never defend the words.

Mr. **YANKELOVICH**. I believe that the unions stress those because they do not have the faith in management; they do not have the faith that they will be consulted; they do not have the faith that these things will happen. With that lack of faith, you fall back on those solutions, but they are not necessarily the preferred solutions. They are not in keeping with the spirit of most Americans where there is a potential for restoring growth, for restoring competitiveness, for moving ahead.

Dr. **APPELBAUM**. I would like to comment on that, also.

Dr. Brinner was talking about macroeconomic policy and essentially talking about the fact that we ran into an inflationary situation. The question was how to deal with it.

One of the serious problems, which is not a problem of this committee, but I just want to mention it in terms of what you are thinking about—one of the serious problems we have in this country is that we have only two kinds of policy—monetary policy and fiscal policy. When we run into a problem of inflation, there seems to be nothing to do except cause a recession. I mean, I could have thought of many other things. I surely never would have gone to tight money to solve the problem. But if you are limited to monetary and fiscal policy, you are always going to seesaw between tight money and loose fiscal policy. You cannot get away from it.

The problems that Dr. Brinner was describing were essentially problems of income distribution. The fact is that oil prices went up; real income in this country went down. But not everybody's real income went down, and struggle was over whose real income was going to go down. It was not only unions fighting to preserve their piece of the pie, but even in the political process, the elderly struggling to maintain the social security system. We have no policies in this country that deal with income distribution. If you think the White House would not have me on my labor policies——

[Laughter.]

That is the other issue. We did not have to have massive unemployment. We could have resolved the problem in other ways.

Mr. **Walgren**. This is a quorum call in which we will ultimately get the chance to reduce somebody's real income, and we don't want to miss that. [Laughter.]

Mr. **Dymally**. And distribute it in a different way.

Mr. **Walgren**. And distribute it in a different way and a more fair way. [Laughter.]

Let me ask, if I might—Mr. Dymally, would you like to ask anything further?

Mr. **Dymally**. No, thank you, Mr. Chairman.

Mr. **Walgren**. Dr. Appelbaum, you indicated that when you looked at the insurance industry you were surprised that the job sector for women was growing, or that job participation for women was growing.

Dr. **Appelbaum**. Yes.

Mr. **Walgren**. In some ways, the job sector for men was shrinking, but you did not say why. Why was that?

Dr. **Appelbaum**. Actually, what I would like to do is someday get somebody to fund a study on technology in the service sector. We cannot get inside. Maybe DRI has something. It may be proprietary information. However, the Government does not have, and has not done, studies of technology in the service sector. Therefore, I am dealing strictly from aggregate data. I just have what BLS collected, and I can tell you what that says.

It did not show a decline in number of jobs for men. This is an industry—unlike automobiles where the technology is coming in and the workers are going out—this is an industry where technology is coming in and employment is growing.

What happened, however, when you look at the numbers—when you look at clerical employment—there was a large number of male clerical workers in the insurance industry since examiners and adjusters are clerical workers. This has been—perhaps somebody would say—deskilled, but from the point of view of the women it is an upgrading of skills. The job perhaps requires less judgment. Women have been moved into the jobs, and men have been moved out.

I would like to know where the men went. I will tell you one thing that has happened. There has been an explosion in the number of managers in the insurance industry. If I can get inside, I think I will find that is the aging of the male labor force—either that or they have suddenly determined that they need many more managers than anyone could ever have anticipated.

What I do not know is whether the bookkeepers who were displaced were retrained and made examiners—and only newly hired examiners have higher educational requirements—or whether we actually have had unemployment of whole groups of women, high school graduates, and new employment in other groups of women, college graduates. It is hard to answer that question. There is no simple answer.

The insurance industry—you have to remember—prides itself on training and retraining its own workers. Do you see all those letters that people have after their names? Your insurance agent has "CPCU," "CLU." This is employer-paid-for, industry-sponsored education. That is how you get those letters. You take all these courses which the employer pays for. When you pass enough of them, you get these letters after your name.

They are concerned about the training and retraining issue, but they may not know what needs to meet. No one has actually looked at this.

I know from the point of view of the educational institutions within insurance, they would like to meet the need, but they are not certain what it is.

Mr. Walgren. Mr. MacKay has been raising this concept of a set-aside fund, one of the results of which would be to give the employer some incentive not to unemploy that person, because they would then lose their invested asset.

Dr. Appelbaum. Yes.

Mr. Walgren. It strikes anybody that we have every incentive to keep people unemployed in our system and very little incentive to keep them employed.

Dr. Appelbaum. That is true.

Mr. Walgren. Are there any suggestions that would be sort of built-in incentives to keep people employed that do not rise to the level of mandating that they never be fired, if that was a problem under the German system? What about a little, just a little, incentive to try to keep people employed?

Dr. Appelbaum. I think it is an exciting idea.

Mr. MacKay. It works exactly that way with unemployment. People have a real incentive not to have unemployment claims because, if you do, your rates go up. The employer has incentives.

Mr. Walgren. I see.

Mr. MacKay. I would think if you took the exact same thinking of the unemployment compensation system and just expanded it to include a retraining concept——

Dr. Appelbaum. I think it is a pretty exciting idea, anyhow.

Mr. Yankelovich. The regional concepts of pensions was to hold people in. When you went to portable pensions, it canceled that. If you could now substitute the notion that an individual builds up some working capital—if he stays with the company, it stays in; if he goes, it goes with him. That is building an incentive the other way, retaining flexibility and not imposing rigidity.

Mr. **Walgren**. We obviously saved the most interesting for last. Thank you very much for both your contributions.

[Whereupon, at 5:36 p.m., the subcommittee and task force recessed, to reconvene at the call of the Chair.]

APPENDIX

Additional Materials Submitted for the Record

Charles H. Miller
Director—Public Affairs

AT&T
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July 21, 1983

The Honorable Doug Walgren
Committee on Science and
Technology
Subcommittee on Science,
Research and Technology
2441 Rayburn House Office Bldg.
Washington, D.C. 20515

Dear Congressman Walgren:

We have been asked by your Committee to submit a written statement dealing with the role of technology in employing disabled workers. Attached is a statement by J.F. Rochlin of American Telephone and Telegraph Company, along with a handbook which is used throughout the Bell System as an aid to its managers.

Very truly yours,

CHM:bls

Attachments

Statement of Jay F. Rochlin
District Manager of AT&T
Regarding the Role of Technology in Employing Disabled Workers
Summary

Over the years the Bell System has gained some important insights in making employment accommodations for our disabled employees. A key element in optimizing any employee's contributions is focusing on the positive skills and abilities which they bring to the job. In concert with this concept is the recognition that people with disabilities are people with abilities and that technology helps us to "tap" these resources. With technology we can hire disabled persons and place them in jobs according to their abilities and not according to their disabilities.

Traditionally, handicapped people have been hired into jobs that were stereotyped to their particular disabilities. This is contrary to the Bell System's objective of placing people according to what they do best. A wide variety of "nontraditional" placements within our company reflect this corporate objective.

Although technology plays an important role in helping us to utilize disabled people, it must be accompanied by high level management commitment and the necessary guidelines, procedures, and resources to allow managers to implement technology. The use of Accommodation Review Committees (ARC's) has been an important vehicle to guide Bell System managers in making accommodations for disabled employees. In addition, the designation and training of Handicapped Job Accommodation Specialists and the development of the Bell System Reasonable Accommodation Handbook have been important elements in our overall program.

The Bell System experience disagrees with common perceptions that accommodations for handicapped employees are expensive and that accommodations involve "high" technology. In many cases "low" technology serves just as well - half of all our disabled employees either need no accommodations at all or require accommodations resulting in no cost to the company. A key to cost containment, as well as effectiveness, is handling accommodations on a case-by-case basis and involving the handicapped employee.

A wide array of accommodations have been made for Bell System disabled employees. One relatively new accommodation for blind long distance telephone operators involves technology that was specifically developed for this job by the Bell Telephone Laboratories. Although this is an important innovation we are sensitive to the possibility of creating a new stereotyped job for blind people. Consequently, we are reminded of the importance of a good match with an employee's motivation and qualifications.

UNITED STATES HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON SCIENCE,
RESEARCH AND TECHNOLOGY

Statement of
J. F. Rochlin

On Behalf of
American Telephone and Telegraph Company

July 22, 1983

Mr. Chairman and members of the Subcommittee, I am Jay F. Rochlin, AT&T District Manager - Equal Employment Opportunity and Affirmative Action. I am responsible for formulating corporate policy and assisting management in the implementation of affirmative action plans concerning the employment of handicapped people and disabled veterans.

The Bell System Experience

The Bell System welcomes the interest of this subcommittee in the issues of how technology affects the employment of persons with limitations. The Committee on Science and Technology has played a vital role in stimulating national attention to and debate about the role of technology in advancing employment among one of our nation's most vulnerable populations. The current set of hearings looking into the role of technology in employment continues the important work of exploring technology's impact on disabled and handicapped job-seekers and workers.

The Bell System, too, is conscious of its role in this area. As one of the nation's largest employers, with just under 1 million employees, we encounter the issue of employment accommodations for handicapped individuals and disabled veterans quite frequently. This issue pertains to applicants for employment, to current disabled employees, and to workers who become disabled while employed by the

Bell System. Over the years, in dealing with these situations, we have had the opportunity to develop some knowledge and experience in this area, which we are pleased to share with the subcommittee.

My following statement focuses on several important areas: optimizing employee contributions and practicing equal employment, the role of technology, removing stereotypes, facilitating reasonable accommodations, matching qualifications, controlling the cost of accommodations, and working on a case-by-case basis.

Optimizing Employee Contributions and Practicing Equal Employment

The Bell System endeavors to employ and retain in employment the best people possible. We want our employees to perform optimally, by contributing in those occupational categories in which they have the most to offer our corporation.

A key factor in optimizing any employee's contribution is focusing on the positive skills and abilities which they bring to a job. In concert with this concept is the recognition that people with disabilities are also people with abilities -- abilities that our Company needs and abilities that technology helps us to "tap."

The Role of Technology

The role of technology in facilitating the contribution of a disabled employee is analogous to using technology to enhance operations for word processing and other office support functions. For example, the Bell System could supply clerk typists with manual typewriters. But recognizing that productivity rises with the use of electric or electronic typewriters, word processors, and other similar devices, we no longer rely on manual equipment. Personnel make better use of their time with these more advanced aids and the job is completed in a shorter time. As a result, the Bell System becomes more productive. Similarly, we rarely use carbon paper any more, instead we prefer copying machines. The cost may be somewhat greater, but the quality of the copies, their longevity, and their readability all are higher.

The same general principle applies to technology that assists persons with disabilities. With "reasonable accommodation" aids and devices, these persons are more productive than they would be without these technologies.

Equally important to the Bell System is the fact that with technology we can hire disabled persons and place them in jobs according to their abilities and potential contributions to our Company -- and not according to their disabilities. This is a key objective in our programs to employ disabled people.

Removing Stereotypes

Traditionally, persons with disabilities have been hired, if they were hired at all, into jobs that were stereotyped to their particular disabilities. For instance, if you were deaf, chances were you were placed in a printing plant or other noisy location -- regardless of whether or not you were interested in or skilled in that kind of work. That is exactly what the Bell System does not want to do.

We recognize that people differ -- some rate highly on "people" orientation, others are good with "ideas" work, others are skilled with jobs involving "things", some work well in small groups as leaders of others, some are gifted in analysis and interpretation of data, and still others are very talented in work involving administration and coordination.

If our disabled employees (as well as other employees) are to be maximally productive, our objective must be to hire, place and advance them according to what they do best, not according to what is done by other people with similar disabilities.

Our objective is reflected in examples of deaf people doing station installation work (normally thought to require good hearing), blind people doing personnel interview work (usually thought to require good vision), and quadriplegic individuals doing operator work (typically thought to require good manual dexterity). These are so-called "nontraditional" placements. But we did not make them to be innovative or nontraditional; we made them because the individuals involved were highly qualified and motivated for those kinds of jobs. And we were able to make these placements with the help of technology. As an aid to solid personnel practices and high-level corporate commitment, technology helps us to meet our objective of hiring the best people possible and placing them where they can be most productive.

Technology Follows Policies, Guidelines and Procedures

In the Bell System, decisions about technology in the employment of handicapped individuals and disabled veterans are not made in isolation. They follow the development of policies, guidelines, and procedures. Whatever success we have had in this area can be attributed to several important activities: placing priority on securing high-level management commitment to employ persons with limitations, drawing up policies to guide our managers in this area, developing procedures to spell out what steps were to be taken in what order, and devising guidelines offering managers the resources they needed to be effective.

Facilitating Reasonable Accommodations and Matching Qualifications

An important vehicle for guiding our managers has been the concept of Accommodation Review Committees (ARC's). These committees are in place in AT&T's major units and in the Bell Operating Companies (BOC's). They are comprised of representatives from the following disciplines: equal employment, medical, legal, buildings and real estate, and other departments. The ARC's have authority to provide guidance to line managers and to make final decisions on behalf of the unit about complex accommodation questions and issues.

These Committees have approved and directed implementation of the following corporate policies which guide our accommodation decision-making: we will make "reasonable" accommodations for work-related limitations; we will consult with the disabled individual about all accommodation decisions; and we will work with state agencies and other community organizations in securing resources to acquire and maintain aids (however, if community resources do not suffice, we will assume reasonable costs ourselves).

Another important policy obligates our personnel staff to ascertain that a handicapped applicant is qualified for a particular job before considering accommodation needs. In other words, first we match qualifications against criteria, and then we review accommodations. During this process our medical staff informs personnel staff about job-related limitations applicable to the specific job for which application has been made. There is no release of information about medical conditions or "handicaps" from medical to personnel unless required by the safety and health of the individual.

Personnel procedures also call for supervisors to discuss accommodation needs with reporting disabled employees. If in the supervisor's opinion a given accommodation is necessary and/or helpful and considered to be "reasonable," the supervisor may approve the accommodation. For more difficult decisions, the Accommodation Review Committee may be consulted for a final determination. Procedures also call for accommodation decisions to be documented and reported, so that the company can track the efforts it makes in this area. Throughout the accommodation process company experts may be involved.

Handicapped Job Accommodation Specialists

The corporate procedures also call for certain staff members in each of the Bell System's units to be designated and trained as accommodation experts. These Handicapped Job Accommodation Specialists are familiar with the aids and devices available locally and nationally and are acquainted with community and national resources on accommodation. In addition, they have available to them the Bell System Reasonable Accommodation Handbook, a 350-page guide to aids and devices for accommodating disabled persons on the job. A copy of this Handbook has been included for the record. AT&T has donated the Handbook, together with rights to sell and reprint, to the National Center for a Barrier Free Environment, in Washington, D.C., so that this resource can be made available outside the Bell System.

Other corporate guidelines provide for the development and maintenance of ongoing relationships with nonprofit organizations locally and nationally. For example, AT&T works with the National Technical Institute for the Deaf at Rochester Institute of Technology. On a continuing basis NTID offers us expertise in the field of deafness when needed to accommodate the needs of our deaf employees. Similarly, we work closely with state vocational rehabilitation agencies, federally funded research and training centers, and other resources on a regular basis to ensure that we always have available the best information and technical assistance possible in meeting the accommodation needs of our employees.

Controlling the Costs of Accommodation

There is a common perception that accommodations for handicapped employees are expensive. However, in our experience that usually is not true. Company studies have shown that fully half (50%) of all our handicapped employees either need no accommodations at all or require accommodations resulting in no cost to the Company. An additional 25% need accommodations which cost $100 or less.

The key to controlling costs is involvement of the handicapped employees themselves as well as Handicap Job Accommodation Specialists. Often, what is needed can be accomplished readily and inexpensively.

There is also a perception that accommodations involve "high" technology. On the contrary, we often have found that "low" technology serves just as well, if not better. For example, a supervisor can use memos to communicate orders to a deaf employee, a quadriplegic operator can use a pencil eraser tip to key equipment controls, and wooden blocks placed under a desk can enable an employee in a wheelchair to be more effective.

Working on a Case by Case Basis

The aids or devices chosen for a particular employee should depend upon the individual's unique needs and upon the specific job tasks to be performed. For this reason all accommodations decisions are made on a case-by-case basis. To illustrate, take the hypothetical career of Jack Jones, a deaf employee.

Jack begins his employment with the Bell System as a maintenance specialist in one of our garages. Because this assignment involves repairing our telephone trucks, "reasonable" accommodations may be as simple as pencil-and-pad communication with his supervisor and some sign-language training for co-workers. Accommodations might also include a TDD (Telecommunications Device for the Deaf) for Jack's supervisor to use in communicating when Jack is at home. (For example, when Jack reports illness.) Jack's next job involves work in an office as an administrative assistant. For this assignment an additional accommodation would be an interpreter who is contracted for biweekly staff meetings. Later in his career when Jack becomes a manager supervising ten employees, he needs a secretary who has interpreting skills and a speakerphone to help him maintain personal and telephonic communication with others in the Company.

A Wide Array of Accommodations

Bell System experience reveals that a wide array of accommodations have been made for our disabled employees. They include the following: TDD's for deaf and speech-impaired employees; tape recorders, "talking" typewriters, Braillewriters, Optacons, magnifiers/enlargers, and similar devices for blind employees; ramps, folding evacuation wheelchairs, grab bars, and similar aids for mobility-impaired workers; structured procedures and task-by-task training for mentally retarded employees; written versions of orally presented material and taped versions of printed material for persons with learning disabilities; safety and health procedures for employees with epilepsy and other medical conditions; and stress-reducing managerial strategies for mentally restored workers. Some of these accommodations involve hardware -- aids and devices. Some involve people, such as interpreters for deaf persons and readers for blind individuals. Others involve procedures, such as task-by-task training for retarded employees.

Occasionally, we encounter an accommodation requirement we cannot meet using commercially available equipment or generally available specialists or procedures. In these cases, we may develop our own accommodations. This was the case when Bell Telephone Laboratories designed the technology to be used by blind individuals working as long distance operators. The system which was developed is known as Traffic Service Position System/TSPS Information Processing System (or TSPS/TIPS). This system enables a blind person to perform the full operator services job by using audible and tactile cues to receive information which usually is available visually to operators. TSPS/TIPS work stations went "on-line" in Cleveland, Ohio, in January, 1983 and are scheduled for introduction in other offices nationwide in the coming months and years. For the record I have attached a copy of the January 1983 issue of the Bell Laboratories Record that includes an article (p. 25) describing the TSPS/TIPS equipment in more detail.

Even though TSPS/TIPS is an important innovation, we must take precautions to ensure that this technology does not merely lead to new stereotypes, such as a new "blind job." For this reason we in the Bell System are determined to place persons with vision limitations in TSPS/TIPS positions because of a good match between the work and the employee's motivation and qualifications. Similarly, we will facilitate future movement to other assignments as employee interests change. Whenever possible we will endeavor to use technology to enhance these opportunities.

Summary

The Bell System has found that there are several important ingredients to an effective program of hiring qualified handicapped individuals into jobs that interest them and that enable them to contribute to the corporation. Accommodations for disabled employees often cost us little or nothing, yet they make our people more productive and our employment opportunities more truly equal.

In the Bell System, technology serves corporate policy and enables us to achieve productivity enhancement, equal employment opportunity, and the best possible services for our customers. We think that is how it should be.

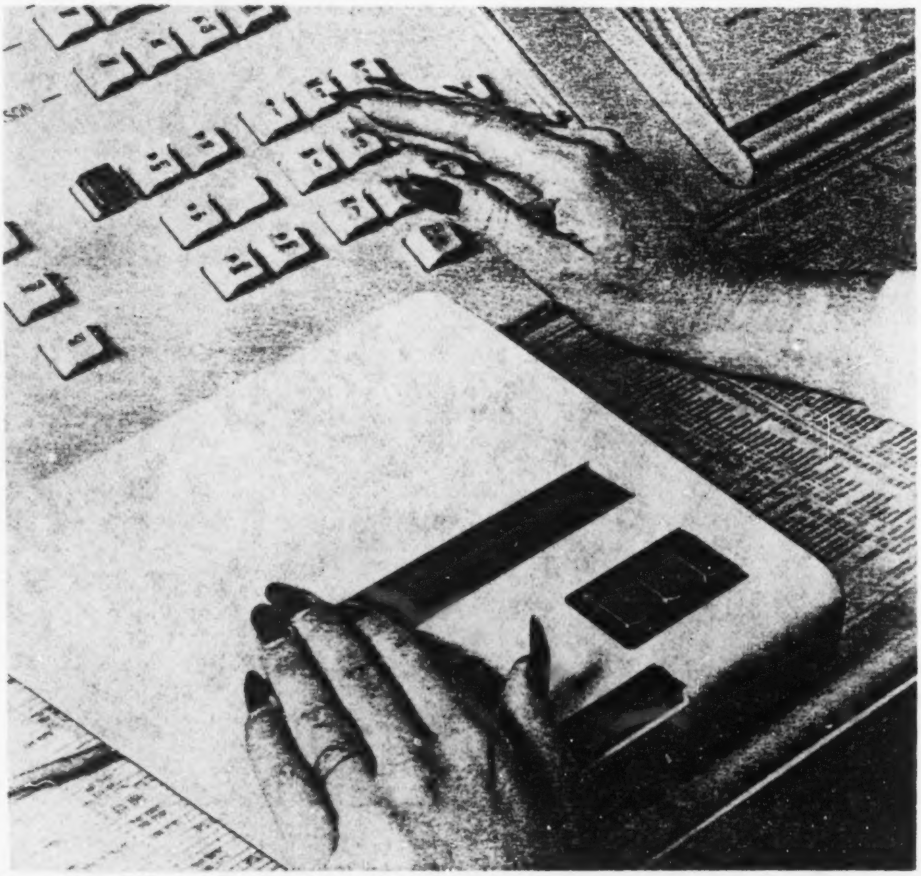
BELL LABORATORIES
Record
JANUARY 1983

Inside this issue:
- Picosecond optical electronics
- Switching, past to future
- Amos Joel interview
- Visually Impaired Operator System

TSPS Visually Impaired Operator System:

Opening up job possibilities for visually impaired people

T. MICHAEL BAUER AND
THOMAS W. BENKO



Fingertip information. Visually impaired persons can be highly-skilled TSPS operators if the visual signals of a TSPS operator's console can be converted into audible and tactile signals for them to understand. This Braille tabletop console, part of the TSPS Visually Impaired Operator System designed by Bell Labs, does just that, opening up new job possibilities to visually impaired persons.

About 1.7 million Americans are either blind or have a severe visual problem, and about 40,000 more people are stricken with a visual handicap each year. More than half of these people are employable, but less than one-tenth of their number are working.

Why then are so few people employed? It is not because they don't want to work, or are incapable. Proof of that is a distressing labor statistic—50,000 to 75,000 people with severe vision problems are listed as "discouraged workers," people who tried but continuously failed to find work and have just given up.

The problem clearly is not one of motivation; the problem is that the world is designed for sighted people.

As part of its commitment to employ physically impaired people, AT&T has been looking closely at the problem of equipment design, seeking ways to open up new employment opportunities. After all, the telephone itself offers few barriers to blind people—just 10 finger holes on a rotary dial, 12 buttons to push on a Touch-Tone™ telephone.

Since there are 154 TSPS systems serving 324 operator complexes throughout the Bell System, with more than 42,500 operators, such a development could offer the possibility of many jobs for visually impaired people.

TSPS is a processor-controlled operator service system that gives an operator more time to serve customers with special calling needs by automating most of the routine, time-consuming functions such as handling coin, credit card, hotel/motel guest, and other traditionally operator-assisted calls.

A visually impaired person can't use a TSPS console as it stands because most of the information on a call is presented to the operator visually through light-emitting-diode (LED) displays, lamps, and lighted buttons.

Audible and Braille signals

For example, when a call is routed by the computer-controlled TSPS to an operator's console, a lamp lights to tell the operator if the call is coming from a noncoin, coin or hotel phone, and whether the caller has dialed the operator, the called number or both. At the same time, the caller's number or the number being dialed can be shown, if needed, on the console's LED display.

Since the TSPS console provides no audible cues that could describe these functions to a visually impaired operator, trials were held by Southern Bell and Pacific Telephone beginning in 1977 with experimental equipment.

Following these tests, the Bell System contracted with Telesensory Systems of Palo Alto, California, to help develop a system, called the Visually Impaired Operator System (VIOS), that would convert the call information on a TSPS console into audible and Braille signals. Telesensory designed a microprocessor-controlled Braille tabletop console and earphone to transmit information on calls to a visually impaired operator. This system is called the TSPS Information Processing System (TIPS). Bell Labs developed the interface system between TIPS and the TSPS, called the Visually Impaired Operator Interface (VIOI). AT&T and Bell Labs managed the field tests and ensured that the system met Bell System specifications.

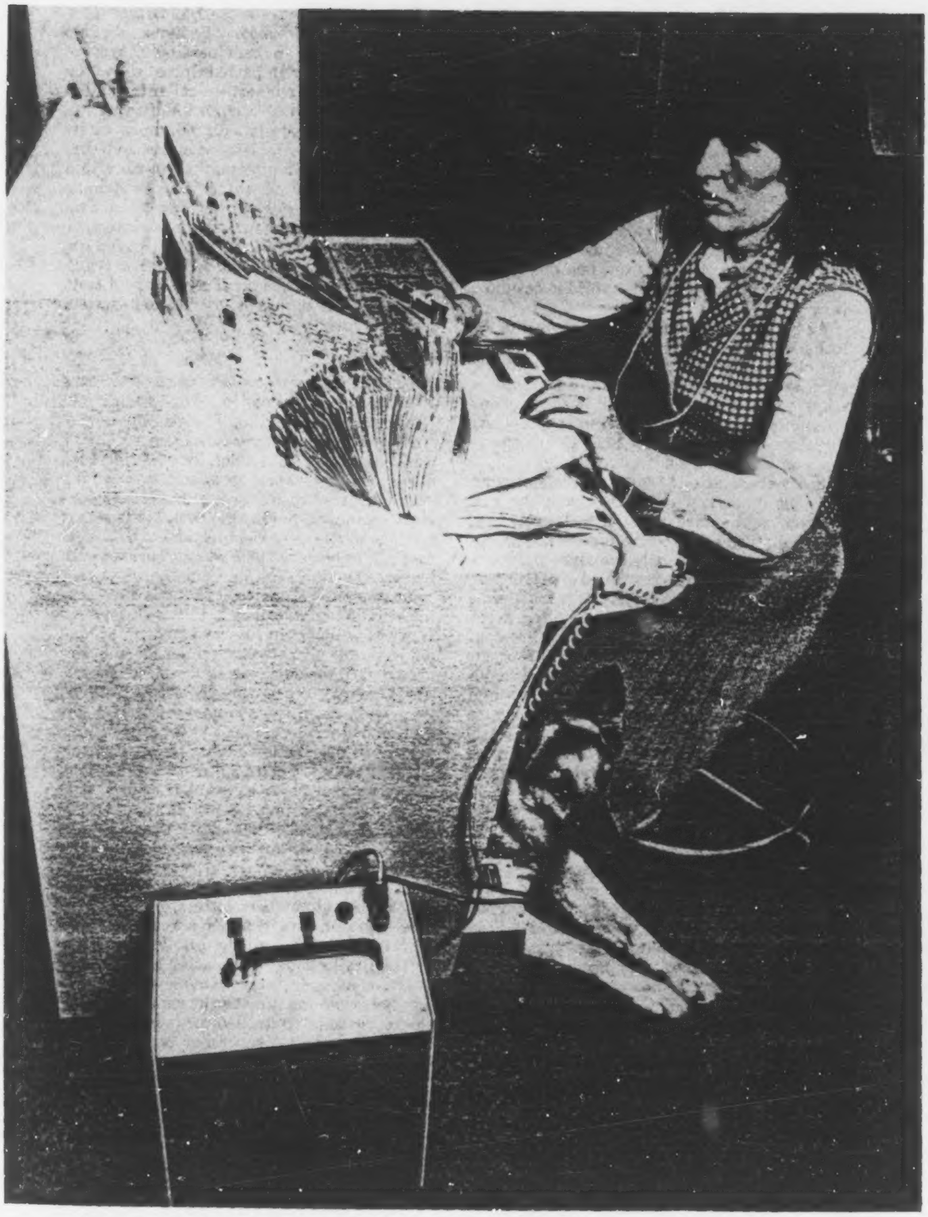
System tested

The VIOS system was first tested on a TSPS 100C trainer console at Bell Labs Indian Hill Laboratory, Naperville, Illinois, by a specially trained blind operator from the Little Rock, Arkansas, TSPS office. The test included using training tapes to simulate incoming telephone traffic. Following human factors modifications to the Braille console after that test, the system was field tested at the Sacramento TSPS office in 1980, where it passed with flying colors.

During the Sacramento test, the TSPS sent information on actual calls to the VIOS, which took the information represented by lighted lamps on the operator's TSPS console and converted it into computer-synthesized speech. For example, when the "Noncoin Station" light went on, a voice announced that information over the operator's VIOS headset. VIOS also took information normally displayed on the TSPS console's LED display, such as the telephone number being called, and relayed it to a Braille display panel on the Braille console. The Braille display has six retractable pins in each of 20 rectangular panels, called cells, which extend or retract in response to electrical signals. The patterns formed by the pins represent numbers, letters, or characters. The operator runs a finger across the series of projections to read the information.

The Braille console also acted as a "scratch pad" for the operator, displaying on command any notes the operator had keyed into the VIOS microprocessor-controlled memory, using six Braille keys and a space bar on the Braille console.

Measuring 8½ inches wide by 9 inches deep, the Braille console is slightly smaller than a



On the job. As TSPS operator Betsy Whitney efficiently handles a customer's call at the Pacific Telephone TSPS office in Sacramento, Calif., her guide dog, Merriah, unobtrusively lies under the TSPS console. The prototype of the VIOS Main Processing Unit, which controls the audible and tactile signals that are sent to a visually impaired TSPS operator, is located adjacent to the console.

typical computer keyboard, and it fits neatly on the TSPS console workshelf. Because the operator must reach over the Braille console to reach the TSPS function buttons and keypad, the unit is only 2-9/10 inches high.

The Braille console has an 8-bit microprocessor chip, 64 bytes of random access memory and a kilobyte of read only memory to handle signal communication between the Braille keyboard and display, and the VIOS main processing unit.

The Braille console is connected by a plug-in cord to the main processing unit which sits on the floor next to the TSPS console. This processing unit, an 8-bit microprocessor, has 6 kilobits of random access memory and 12 kilobits of read only memory. The processing unit receives information from the interface, processes it, and transmits the information either through the operator's headset or the Braille console. The processing unit also handles instructions from the Braille console, stores the operator's notes and continually diagnoses TIPS operations and the condition of both the data and the data line to the interface. The processing unit also controls a speech synthesizer that translates the TSPS lamp signals into synthesized voice descriptions for the operator.

The operator's headset consists of two earphones. One earphone provides the normal voice information from the TSPS console. The second earphone plugs into the processor unit for the synthesized voice descriptions of the TSPS function lights. Separate earphones prevent one signal from obscuring the other and

Operators test the system

There is always a special burden placed on someone breaking new ground, particularly if the result of the effort will mean a great deal to others.

Ann Robson and Betsy Whitney know the feeling well. They were the principal operators who tested the Visually Impaired Operator System and proved it worked.

Both women are blind. And both are very efficient TSPS operators. Ms. Robson had been involved with earlier tests. She was a volunteer, working with the Arkansas Enterprises for the Blind, when she was asked to participate in Southwestern Bell tests.

"Southwestern Bell hired and trained me as a TSPS operator," she said, "and while it certainly was work, it really was not that much trouble." In the course of the early tests she proved a visually impaired person could do the job.

When Telesensory Systems, Inc. and Bell Labs developed the prototype VIOS system, Ms. Robson spent two weeks at Bell Labs Indian Hill Laboratory testing the system on a TSPS 100C trainer, working out the bugs before the system was field tested in Pacific Telephone's Sacramento office.

Based on Ms. Robson's experiences, several hardware and software modifications were made to VIOS, convincing its designers that the success of the Sacramento trial was all but ensured. Their sense of optimism, however, didn't alleviate the sense of responsibility Ms. Whitney was bringing to the project.

"I knew that the test, on a live-traffic TSPS console, was going to be hard work, and it was, for all of us in the office," she said. "I knew it would require patience, that whoever tested the system would have to want to make it work. Too many people were counting on it."

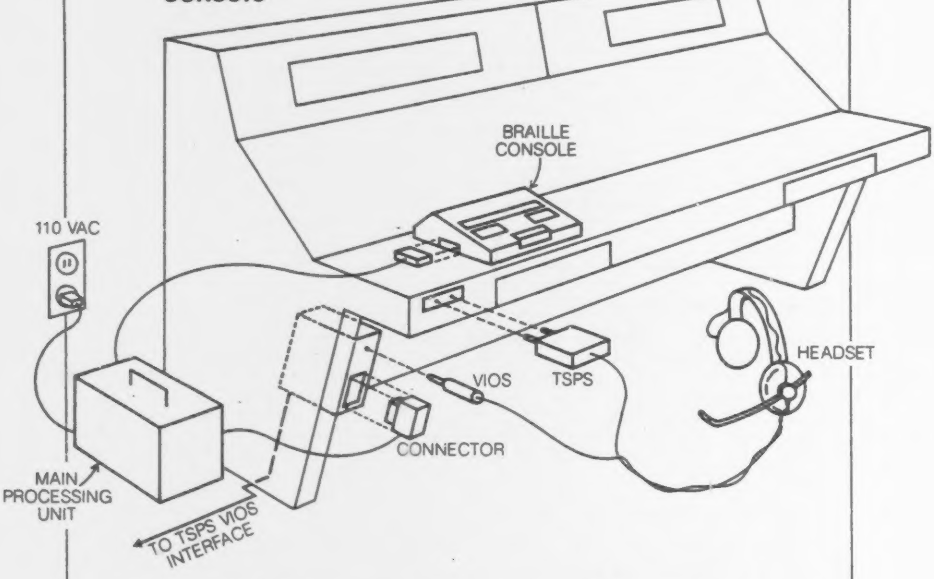
She also wanted to dispel any myths that having a blind person in an office is a handicap to the operation. "That just doesn't happen," she said emphatically.

With the success of the trial now history, both women hope the new VIOS system will provide many jobs for visually impaired people.

Ms. Whitney, who is still with Pacific Telephone, agrees but thinks, "A company shouldn't just think 'We'll give blind people jobs as operators' and let it go at that. An operator's job is where you can start with a company, but you shouldn't have to stop there. Visually impaired people need the challenge of advancement, just as sighted people do."

Ms. Robson, who is with Southwestern Bell and planning to attend college soon, echoed Ms. Whitney's concern. "I'm glad the company expects as much from me as anybody else. That is how it should be."

VIOS operator console



An important advantage to the TSPS Visually Impaired Operator System (VIOS) is that visually impaired and sighted operators can use the same TSPS console. Both the VIOS Braille Console and the VIOS Main Processing Unit are portable and can be stored when not needed. The only modification to the TSPS console or position is the installation of a receptacle underneath the workshelf for the VIOS earphone jack and the main processing unit's connector. The data links from the receptacle connect with the VIOS interface to the TSPS. Signals from the TSPS to the operator's console are also sent from the interface to the main processing unit where they are converted to voice and tactile signals for the visually impaired operator.

confusing the operator.

Because the VIOS had to be compatible with both the TSPS 100B and the TSPS 100C operator consoles, the VIOS interface was located in the TSPS subsystem where the differences between the two consoles are at a minimum, rather than at each console. This approach eliminated the need for two radically different interface units, and permits up to eight VIOS units to operate off one central interface.

In order to facilitate training of visually impaired operators, the interface and VIOS units are also compatible with the TSPS 100C training position, although some modifications had to be made in the interface software. An interface can control up to two TSPS 100C trainers.

The interface is controlled by an 8-bit microprocessor, and its software is stored in ultraviolet-erasable, programmable, read only memory. To keep per-unit costs down, the interfaces consist mostly of standard parts.

Three data links run from the processing unit to the interface. The interface constantly monitors the traffic information being sent by the TSPS to the TSPS consoles, and when it recognizes a call going to a console that has an active VIOS, it transmits that information over one of the data links to the VIOS for translation. The second data link conveys VIOS information to the interface, and the third link connects the VIOS to a printer in the administrative area of the office.

The third data link and the printer provide for one of just two accommodations that have been made in office procedures for visually impaired operators.

"Ticket" information

Normally when a customer is due a credit for, as an example, reaching a wrong number, the operator uses a special pencil to fill out a "ticket," a computer card with multiple-choice boxes that designate action to be taken. Since a visually impaired operator can't fill out these cards, the operator uses the Braille keyboard to enter the information in the TIPS memory, then transmits the information to the printer for a printout copy. A sighted person then fills out a ticket from the information on the printout.

A printer interface permits up to eight VIOS units to use the printer. Each unit stores the most recent 4000 characters of "ticket" information, so if a printer malfunctions, ticket information can be retrieved from the computer's memory.

The other accommodation in office procedures involves providing a visually impaired operator with information on the rate to charge for calls. Normally, an operator refers to a multi-card, looseleaf index located on the TSPS console workshelf. In preparation for the Sacramento field trial, this information was translated into Braille, which wound up filling three looseleaf binders. When the binders proved unwieldy it was decided the visually impaired operator could dial regular Rate and Route Operators any time rate information was needed.

Other information, such as the emergency telephone numbers, business office numbers, and dialing instructions were taken from the multi-card index and the bulletins placed under the Plexiglas cover of the TSPS console workshelf, and translated into a special multi-card Braille file and placed on the TSPS console where the rate information normally would be.

Other than these minor changes, no modifications are necessary to any TSPS console where a VIOS unit is located.

To understand how the VIOS system works, let's follow the normal procedure of a visually impaired operator as he or she starts the workday.

Since the VIOS main processing unit and console are portable, weighing about 20 pounds, the units can be either stored or left at the TSPS console when not in use.

The operator places the processing unit next to the TSPS console and plugs into it the data link line from the interface, and then the VIOS earphone line. There are no electrical hazards at this point since all the plugs are "dead" connections.

Now the operator is ready to "power up." By pressing the "On" button on the processing unit, the operator triggers the unit to diagnose itself, checking its memory and other functions, and activating all the pins on the Braille display. If the VIOS fails this internal diagnosis, it reports "Error" to the operator in Braille and by voice, and to the printer.

If the system passes its internal diagnosis, it sends a command to the interface, saying in effect it is ready to go. However, the interface performs its own diagnosis first, checking its data link to the processing unit and double-checking the processing unit by giving it some basic commands and prompting the printer to run through the alphabet. If all is well, the system tells the operator "Ready" in voice and Braille and has the printer type out the word as well.

The whole diagnostic process takes about ten seconds.

Logging into the system

Once the system is ready, the operator logs in on the TSPS console, alerting the TSPS that the console is ready to take calls. TSPS isn't aware of the presence of the VIOS system, however, only that the TSPS console is available for calls. As the TSPS sends out call information to the TSPS console, activating the appropriate console lights and LED displays if needed, the interface detects and transmits similar signals to the VIOS for translation into voice and Braille. The interface continually diagnoses itself during lulls and if errors are detected alerts Service Operations.

Human factors considerations

A guiding principle behind the development of the Visually Impaired Operator System (VIOS) was that the operator's job shouldn't be modified, only the way the work is done.

The objective was to have visually impaired and sighted operators doing the same work, at the same rate, and with basically the same tools.

As a result, both visually impaired and sighted operators can use the same Traffic Service Position System (TSPS) console interchangeably, and provide the same services so efficiently that the customer cannot tell if the operator is handicapped.

The VIOS hardware and software are designed to provide the visually impaired operator with the same information that is provided to a sighted operator. However, a human factors study of the system was critical to ensure it provided an efficient interface to the operator.

Early evaluations of the system on a TSPS 100C training unit at Bell Labs Indian Hill Laboratory were favorable, although some improvements were made.

One such improvement involved five special function keys on the top of the Braille console. Originally, four keys were provided to permit the operator to recall information from the VIOS computer memory on the kind of call being made, the class of charges, information on the loop and other miscellaneous data on the call. The fifth key activated the printer in the office's administrative area.

Occasionally the operator would inadvertently hit one of the keys while reaching over the Braille console to reach a TSPS console button. The keys were eliminated from the console, and the software was revised to control those five functions through the Braille keyboard. This change also simplified the operation, since all VIOS functions were now being controlled through one medium.

Another software change involved the way information was entered by the operator into the VIOS computer memory, either to provide ticketing information for the attached printer or for the operator's own notes.

This early testing and human factors evaluation ensured a successful live-traffic test and an efficient interface between the operator and the system.

The field trial at Sacramento indicated several other human factors changes that should be made, mostly in software.

There was, however, one "canine" factors change that had to be made as well.

One of the operators' guide dogs, bored and looking for something to do one day, started to gnaw on a dropped pencil, and then it found a stray doorstop to chew on. The craft personnel finally drew the line when the dog took to chewing on a cable to the VIOS main processing unit. One final conclusion drawn from the trial—install the cables so a guide dog can't get at them.

As the operator receives voice and Braille signals, he or she uses the TSPS console to handle the call, just like any sighted operator. Because the 87 buttons on the TSPS console are grouped logically according to function, the visually impaired operators had little difficulty in memorizing their location.

As a precaution, however, the interface monitors the signals in the TSPS to detect which buttons have been lighted, and relays that information to the VIOS, so the synthesized voice can inform the operator what buttons were pressed as a double check. However, the keypad doesn't have this feedback feature.

To date, several companies have indicated they plan to install more than 100 VIOS consoles, the first of which will be placed in service by Ohio Bell in Cleveland early this year. One system is scheduled for installation in Charleston, West Virginia, in April, and another is due for Little Rock in May.

Since each VIOS unit opens one to two job opportunities for visually impaired operators, depending on shift scheduling and office traffic levels, the development of VIOS is a meaningful example of the Bell System's dedication to opening up as many jobs as possible to handicapped people. ☐

IMPACT OF TECHNOLOGY ON EMPLOYMENT
(FOR DISABLED PERSONS)

Prepared for
The Committee on Science and Technology
U.S. House of Representatives
June, 1983

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IMPACT OF TECHNOLOGY ON EMPLOYMENT
(FOR DISABLED PERSONS)

The information presented in this written testimony is based on work done since 1975 at Sensory Aids Foundation (SAF) in Palo Alto, California.

Sensory Aids Foundation is a non-profit corporation which puts technology to work helping handicapped persons enter the job market. Sensory aids, devices which strengthen or replace a sense that has been lost or diminished, and utilizing both low and high technology are used in our placement activities. Throughout California, since 1975, with program funding provided by Projects With Industry, CETA, the State of California and private funds, SAF professionals have assisted over 350 disabled persons in performing competitively in jobs which were previously not open to them. These people, primarily blind and partially sighted, are working in a wide range of professional jobs, service jobs, clerical jobs, and assemblyline jobs.

Who are some of these disabled persons, what do they do, and what are the devices that enable them to be competitive in their jobs?

- A totally blind man is working as a personnel analyst and affirmative action officer. He has statewide responsibility in California for ensuring that equal opportunities are available to minority and disabled persons. He uses a paperless braille display, a VersaBraille, to access manuals and written documents as well as writing reports. With this device he is able to create print and braille materials simultaneously.

- A totally blind woman is working as an airline reservationist for United Airlines. She receives incoming calls from customers, assists in planning travel arrangement, and reserves all the appropriate airline accommodations. She must have access to this information through a CRT terminal. She uses a reading machine for blind persons, an Optacon, to read the CRT terminal.

- A totally blind woman is working as an insurance claims representative for a large insurance company in Southern California. She gathers the appropriate information from the insured claimant, fills out all necessary forms, and then processes the claim. She uses an automatic form writer, with printer, a device which is a desktop computer equipped with a speech synthesizer. She also uses an Optacon to proofread her completed forms.

- A totally blind man was working as a technical support representative for a computer company. Initially he used an Optacon exclusively but subsequently found that its use in combination with a talking terminal was more effective in reading both printed documentation and terminal information simultaneously. The man did so well that the company promoted him to an inside sales position.

- A totally blind man is an electronics technician for a large electronics company. He is able to read oscilloscope wave patterns through the use of a special device which provides different tones. Digital instruments are read with a device which provides immediate speech output. Schematics, materials, and service reports are read with an Optacon.
- A partially sighted woman is working as a receptionist and bookkeeper. She uses a talking calculator, with tape, which provides voice verification of keyboard entries. She places sheets of her figures under a CCTV camera and reads her computations on her CCTV screen. The numbers can be magnified from 4X to 40X.

These are only a few of the many real life examples which our client files contain of disabled persons at work in competitive employment.

The President's Committee on Employment of the Handicapped makes the following report on who comprises the disabled work force.

> "A U.S. Census Bureau sampling attibutes disabilities to one of every eleven Americans between the ages of 16 and 64, or approximately 11,000,000 men and women.
>
> The National Center for Health Statistics estimates that in professional and technical work alone, positions are being held by 663,000 blind or visually impaired people, 950,000 deaf or hearing-impaired people, 60,000 people in wheelchairs, and 631,000 with missing or non-functional limbs. There are even more disabled workers employed as craftsmen and laborers and in service occupations."

These statistics demonstrate the achievements that disabled persons have made. Increasingly, these persons are entering the labor force as a result of their own commitment, through legislation to improve employment opportunities for disabled persons; through employers witnessing that disabled persons are qualified and that they often exhibit a greater degree of dedication and conscientiousness in their work. Furthermore, present day technology makes it possible to develop many new aids to exploit an increasing job potential. When appropriately utilized, technology enhances the disabled person's productivity. There occurs a decreased dependence on intervention from co-workers and an ability to accomplish a wider range of job related activities.

At this point I shall be specific to Sensory Aids Foundation for further comments and statistics. I must acknowledge many other social service organizations throughout the United States which provide placement services to disabled individuals through Federal and state funding. They, too, attest with pride to their placement results.

SAF's clients in career track employment are experiencing pride in their own productivity, they are enjoying increased independence and mobility, as well as increased self esteem. These are important human values; however, when funds for social services are rapidly diminishing, focus on such human values is not enough.

It is necessary to demonstrate the cost effectiveness of government investment in independence-oriented rehabilitation programs including investment in technological aids which facilitate productivity and independence. Certainly such programs reflect the themes prevalent in Washington today of productivity and financial responsibility.

As an example, I would like to present Sensory Aids Foundation's Return On Investment report based on statistics gathered for a program ending September, 1981 covering 50 placements made over 12 months. The Return On Investment is the ratio of income per year to investment required for the placement. The income amounts to Federal taxes, state taxes, and e reduction in support from the government for each placed person. The investment comprises sensory aids equipment and costs in placement by Sensory Aids Foundation. Our formula reads:

(ROI) FORMULA

$$\text{Total ROI} = \frac{\text{Reduction in Support} + \text{*Federal Taxes Paid} + \text{**State Taxes Paid}}{\text{SAF Employment Programs} + \text{Equipment Investment}}$$

$$\text{Total ROI} = \frac{\$114{,}849 + \$213{,}753 + \$28{,}912}{\$119{,}670 + \$118{,}085} = \frac{\$357{,}514}{\$237{,}755} = 150.4\%\ \text{ROI per year}$$

150% ROI if all welfare subsidy ceases at time of employment
126% ROI if 50% of welfare subsidy ceases at employment
90% ROI if welfare subsidy continues during the first year

Total Cost of SAF Employment Programs for One Year = $119,670

Total Earnings of Employed Clients for One Year = $884,181

Total Sensory Aids Equipment Costs Used in Placements = $118,085

*Total Annual Federal Taxes to be Paid = $213,753
(Estimated on basis of first year salary)

**Total Annual State Taxes to be Paid = $28,912
(Estimated on basis of first year salary)

Potential Total Annual Saving in Welfare Subsidization = $114,849

Average Salary for Persons Assisted by SAF in Employment Activities = $14,736

In 1982 SAF either placed or assured retention in employment of 60 persons.

In just one year these 60 persons will pay Federal and Social Security taxes which equal 90% of the cost of SAF services and the cost of all sensory aids equipment used. The gross first year earnings for these 60 persons total more than three quarters of a million dollars. To give a specific account of an individual case I shall provide the following example.

After education and trials in different job areas, a totally blind young male client of SAF finally found the "right" job for him. He is now working in personnel, a field usually considered too paper-oriented for a blind persons. He must access manuals, written documents, and also write reports. He prefers to work with braille, so he uses a braille writer, a tape recorder, and a VersaBraille, a device which records braille on cassette tape. All of this equipment costs approximately $8000. $8000 is equal to the total federal and social security taxes he pays in one year plus one year's welfare benefits which are no longer required because of gainful employment.

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